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ECONOMIC GEOGRAPHY

JULY

THE CIVILIZING RAILS
Mark Jefferson, *Professor of Geography, State Normal School, Ypsilanti, Michigan*

PIEDMONT NORTH CAROLINA AND TEXTILE PRODUCTION
Jefferson Bynum, *Geographer, University of North Carolina*

LOCATION FACTORS IN THE IRON AND STEEL INDUSTRY
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THE OZARK ORCHARD CENTER OF SOUTHERN ILLINOIS
na C. Robertson, *Economic Geographer, State Teachers College, Valley City, North Dakota*

AGRICULTURAL REGIONS OF SOUTH AMERICA
Clarence F. Jones, *Economic Geographer, Clark University*

EGYPT IS THE NILE
Paul F. Gemmill, *Professor of Economics, University of Pennsylvania*

CLARK UNIVERSITY, WORCESTER, MASSACHUSETTS, U.S.A.

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Dr. Jones, professor of economic geography at Clark University, contributes the third instalment of the "Agricultural Regions of South America," a study based on field work in western and southern South America with original sources for the statistical materials used in the crop and animal maps. In June this year Dr. Jones sailed for northern South America to carry out further reconnaissance and detailed studies over a period of six months, in connection with his agricultural studies of this part of the continent. Dr. Jones is the author of a new book, "The Commerce of South America," from the press of Ginn and Company.

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THE TEXTILES

ALMOST every industry is undergoing transformation since the war, some indeed suffering revolution that seems almost catastrophic, but nearly all profiting by the changes. Agriculture, the coal industry, the chemical industry, and many another, including particularly the textiles, are in the process of rapid evolution.

The rapid development of artificial silk or rayon; the extension of cotton growing into new regions, particularly the British colonial possessions, to compete with the American cotton belt, and the changes within the cotton belt itself consequent upon the widespread ravages of the boll weevil; the expansion of cotton mills in the American Piedmont; these are some of the developments that are engaging the attention of the textile industry and the students who have been called into consultation. Forces which may or may not be directed or controlled are being set into motion, and to predict what their ultimate effect may be engrosses the time and serious thought of the whole industry.

In the United States the readjustment of the industry, due to the spectacular character of the features distinguishing it, such as the rapidly increasing spindlage in the South, the abandonment of mill after mill in New England, the fight on the boll weevil and the attempt to generalize Cotton Belt agriculture, and the sensational rise of rayon to dominance in both manufacture and use, has attracted the attention of the whole country. The successful achievement of this readjustment without permanently unfavorable effect upon national prosperity and international relations is the goal of the government and the industry and the hope of our whole people.

ECONOMIC GEOGRAPHY

VOL. 4 JULY, 1928 No. 3

THE CIVILIZING RAILS

Mark Jefferson

Professor of Geography, State Normal College, Ypsilanti, Michigan

NORTHWEST Europe is indubitably one of the regions of highest culture in the world. It is white on the accompanying map revealing England, Holland, Belgium, Denmark, Germany, Czechoslovakia, and Hungary as having no points farther than ten miles from a railway. And there are none in much the greater part of France, Switzerland, and Austria, and the southern half of Sweden. That means that every field, every factory, every forest, every mine, every village, and every home in all this region is within easy reach of railway transportation, the agency that for the century past has done more than any other single one of man's inventions to transform human life, especially in the way of pushing backward people forward and lifting submerged classes. The old-fashioned peasant, clinging closely to the ways of his fathers, and accepting a status of inferiority, has disappeared here before the whistle of the locomotive and the rustle of the newspaper. Local costumes and customs have had to yield here to the garments and manners of wider areas. The rural dweller here is familiar with the ways of the townsfolk. The movement of persons and goods over the region is very great. It would have been stupendous but for the ingenuity governing classes have used in devising a dozen customs and other barriers and in cherishing the form of love of country which consists of suspicion and hatred of neighbor nations, sentiments which duly blossomed into the terrible war that has just involved so much of this cultured area.

To have advantage from a railway, we do not need to live beside it. We prefer to be somewhat away but in easy reach. How wide is the useful neighborhood of the line? Of course, it varies with the viability of the country between. Five miles of swamp or lofty mountain ridges may be a complete barrier in practice. On fine, hard roads, twenty miles is no great distance. In this study, the author calls it arbitrarily everywhere ten miles on each side of the rails. Each line then provides a twenty-mile-wide band of mobility. The author leaves white all places within ten miles of the railway.

Mobility transforms and ennobles peoples. It has always been so. Mobility along the Nile made old Egypt significant. Mobility on the sea distinguished in turn Phoenicians, Venetians, Norsemen, Dutch, and English. Sea-mobile Carthage compelled sedentary Rome to take to the Mediterranean and greatness. In

Rome as in mediaeval Europe a class of horse owners came early into prominence, and the name of their element of mobility—the horse—still lingers in their titles chevalier, and marshall. The common Spanish word for gentleman, *caballero*, once meant a horseman just as peasant, *peon*, meant once a man on foot.[1] Not merely is the *caballero* a gentleman today, although he has not the horse which made his forbears gentle, but the Argentine workman, though he may now possess one or more horses, is *peon* because he is of the working class. And it is noticed that this Argentine horse-owning and horse-using peon is rendered wonderfully independent and dignified thereby, far superior in his bearing to his horseless blood cousins, the *roto* of Chile and the *chulo* of Peru. Sea-mobility distinguished the early Scandinavians, making them dominate in France and England. The British Empire was founded on British mobility on the sea, and rests today on its maintenance. We forget at times the pains Britain has been at to ensure and safeguard this mobility. What was the Beagle doing there in the Chilean archipelago when Darwin made his famous voyage in her? Charting the chan-

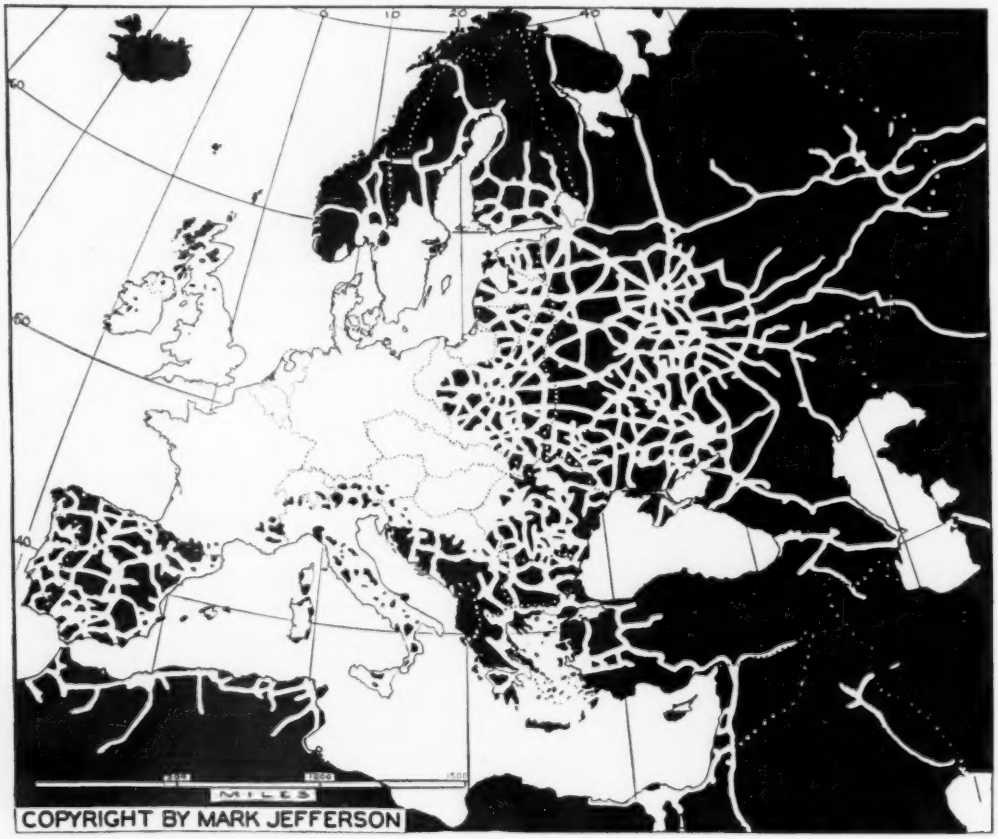

FIGURE 1.—Europe within ten miles of a railway is white. Black regions are farther from the rails. The continuous white area is called a *railweb*, the network of lines as in Spain and Russia a *railnet*.

[1] Meanings the words have now lost, giving place to *ginete* and *andarin*.

nels for all the world to find their way. Theirs are the only charts available for most of those waters and many another out-of-the-way sea path to this day.

Now the Romans, having become masters of the Mediterranean, built roads to extend their mastery from the shore inland. Just so, the Britain which mastered Napoleon and asserted world empire by controlling the seas soon after developed the iron horse and its rail path that have made much of the land surface of the globe as viable as the paths of ocean.

From the Alps to the uplands of Scandinavia in west Europe neighboring bands of twenty-mile width along the railways overlap so perfectly that if the band be white on the map all western Europe is white. There are no interstices. One is always in reach of the rails. The lines and threads of communication are lost in one great fabric of easy transportation, extended and continuous, a very *web* of transportation. This west European *railweb* covers three quarters of a million square miles and is inhabited by some two hundred millions of people. As a work of men's hands, it is most imposing, but its greatest significance is as an implement for spreading culture among men. When it picks up and transports men's bodies, it makes an inevitable impression on their attention. They never fail to take to it with enthusiasm. We may see this in remote regions, negroes "riding the cyars" in Mississippi, to squander pay-day wealth; Hindoos in India or Arabs in Algeria hanging in swarms from the steps of British or French trains. These colored brothers, all jealous to keep their ancient ways of thought untouched by the ideas of Europe, yield their persons eagerly to the white man's vehicle. There is no people so backward that it does not want to "go." This is a beginning of acceptance of the white man's civilization, an acceptance of the idea of white superiority, not as a slave who accepts power that it is too painful to deny, but as a learner who recognizes that his teacher can do things that he cannot and does not yet know how to do.

To move things across the possible

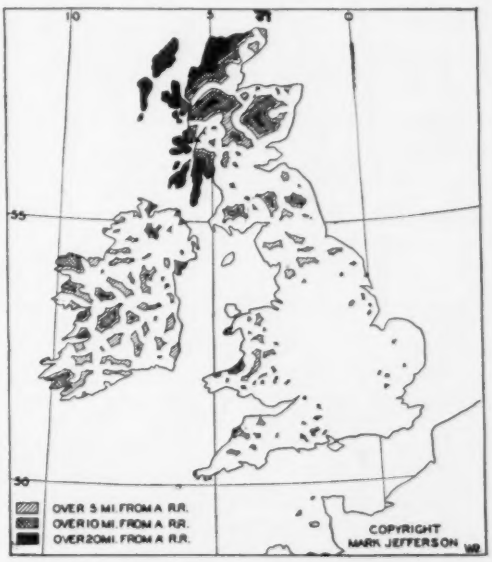

FIGURE 2.—British Isles within five miles of a railway is white. Areas from five to ten miles from the rails are cross-lined and those more than ten miles from the rails are double cross-lined. A small area in northwest Scotland is twenty miles from the railway. Maps for the five- and ten-mile distances would not differ so much as one would suppose.

ten miles within the railweb here are the best roads in the world. All means of transport here are best. These people are "sold on the proposition" of spending much labor to secure easy transportation.

It may seem arbitrary to select ten miles as the critical distance of easy access to a railway. But the distance selected appears to matter less than one would suppose. To test

this, three different widths have been mapped for Great Britain and Ireland. In either case, little of Britain is remote from the rails. This is civilized country. It has few backwoods[2] corners.

The railweb of western Europe is remarkable for the abruptness with which it ends at the Spanish and old Russian frontiers. There is no transition at all. Change of gauge is sufficient reason. "The official gauge of the principal Spanish railways has hitherto, for strategical reasons, been purposely kept different from that of France, and in consequence of this passengers are obliged to change trains at the frontier stations."[3] The Russian roads, too, used a strategic change of gauge to ward off invasion by rail from Germany. This has left Poland, reconstructed from fragments of Russia, Germany, and Austria, with a difficult situation. The edge of the railweb ran squarely across her territory, which was partly within and partly without the web. This is no doubt the reason Poland has built 2,000 miles of railway since 1919. The lined areas on the map show what significant areas this new building has cut out of the former backwoods along the old frontier.

The type of railway communication characteristic of Spain, Portugal, Russia, and the Balkan countries is the net of separate bands of railway movement, the *railnet*. Its feature is the separateness of the individual lines and the distinctness of the backwoods spaces between, spaces often twenty to fifty miles across in which are people who do not travel. Some of them have never left their home region, have never seen a locomotive.

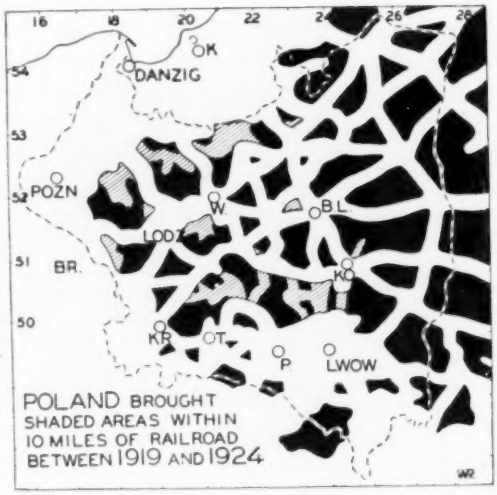

FIGURE 3.—Poland, crossed in the west by the eastern edge of the European railweb, has been busy ever since the War, putting rails through the "backwoods" inherited from Russia, as is shown by the lined areas cut out of the black. She had 7,925 miles of railway in 1919 and in 1924 had 10,534.

Here live true peasants, with peasant costumes and peasant ways. Those who live within reach of the road are town dwellers. Those of the backwoods are country folk. Through their mobility the railway users grow rapidly away from the rural folks. Modern cities are all on the line of the railway.

Mediaeval towns built walls to keep their enemies out and for the most part failed. We have now learned to build the best possible road out to our city limits and put up the sign there "Welcome." We cannot keep people out, it appears, and it is very much more to our advantage to have them come in. In the railnet of Europe are Portugal, Spain, Russia, and the Baltic and Balkan countries, as well as the European strip of North Africa.

The Russian region is marked by the distinct pattern of the strands, a cobweb effect centering about Moscow, Warsaw, the Baltic states, and Finland, as well as on the Donetz

[2] The word is used with no connotation of woods, just out-of-the-way places.

[3] Statesman's Yearbook, 1927, page 1292.

coal basin, just north of the Sea of Azov, but not much about Leningrad or Odessa. The pattern results from the facility of construction on a plain in any direction, together with the planning by central authorities in whom lay all the power of decision. It is the pattern of autocratic rule. In the Balkans and Iberia rough ground locates the lines on the easiest passages and makes the net irregular.

But south of the railweb and in northern Britain occurs a transition region, intermediate between web and net. It is as nearly a web as the great ruggedness of the relief will allow. Alpine masses can be pierced here and there by a tunnel, the cost forbidding their multiplication, but considerable areas will never be approached by the rails. Still it happens that these wild regions are rarely as wide as the belts of mobility along the tracks so that the distinct bands of white across a black background which characterize the railnet are not here apparent, rather spatterings of black in a field of white. It is an *interrupted* railweb.

Beyond the railnets occurs the third type of railway development. This is the railway *tentacle*, such as thrust out eastward toward Asia, four of them; the Trans-Siberian in the north, the line from Samara north of the Caspian to Samarcand and Tashkent, the Trans-Caspian from Krasnoyarsk to Merv and Khiva, and the uncompleted line from Constantinople to Baghdad from which Germany hoped so much. These lines represent the attempts of Russians and Germans to carry their culture into Asia. Shorter but more numerous tentacles thrust from the North African railnet toward the Sahara, offering it the culture of France.

The lines from the Russian net to Archangel on the White Sea and to Murmansk on the Arctic are merely crossing space to reach the ocean. So are the lines across the Norwegian uplands. They are not carrying the light of Europe into a benighted Norway. Bergen and Trondhjem on the Norse coast awakened from the darkness of the middle ages before it dawned in central Europe, thanks to their possession of the seaways while most men were still bound to the paths of the land. Those were the days when colonies were planted in Iceland, the land that is all black today when it is constructing its first railway. But Iceland is not out of the world. It knows what the world is doing, and has acquired autonomy in the general urge of the smaller people for national existence. But vast barren areas are unlikely ever to carry people enough for much development of railways.

A *river link*, the last of our types of railway construction, occurs between Tura and Tavda, two tributaries of the river Ob in the northeast of Europe. The links are characteristic of undeveloped regions where rivers must be used for travel, not because they are good means of communication but because people in those countries have none better. In Russia more than in any other country in Europe rivers are used. So the railways there often terminate on a river to which they deliver their freights. The first road east of the Archangel road terminates at Kotlas on the Dwina and in the wide black mesh next south of the Kotlas-road four of the five points terminate on the Volga, the greatest of Russian rivers. It is quite characteristic that even in so poorly developed a country as Russia the railroads twenty years ago

FIGURE 4.—North America within ten miles of a railway.

were reported carrying 55 million tons of freight, while the rivers together carried but 9 million.

The railweb of North America is rather similar in shape to that of Europe, but somewhat smaller, having an area of less than 550,000 square miles. The people within its borders are hardly a third as many as the Europeans. From the Atlantic

in Massachusetts it stretches through Connecticut, New Jersey, Pennsylvania, Ohio, Indiana, Illinois, and Iowa into Kansas and Nebraska and the Dakotas, crossing parts of Ontario, Michigan, Wisconsin, and Minnesota. The area penetrates Canada in Peninsular Ontario, freely crossed by the New York Central, and again in Manitoba and Saskatchewan. It is familiar that the rails here have supplanted for most purposes the water traffic of the Lakes, which was so important in pioneer and immigrant days. Scrutiny of the railway map at the northern and southern border of the United States shows no sign that man has imposed obstacles to the expansion of the rails. From the Atlantic it extends westward mostly across fertile plains to end in the west at an aridity barrier, the 100th meridian. In Europe the equivalent rainfall occurs about the 30th meridian east and the railweb stops short of it as if it were inhibited by the Russian defensive change of gauge.

Though the people of the American railweb are so much less numerous than their European cousins, and have been so short a time in occupation of their continent, the extent to which they have utilized their railweb has been enormously increased by some happy circumstances, two of which have been easy acquisition of land by all classes of the people and a constitutional prohibition of tariffs within the national area, which other circumstances increased to more than fourfold its original amount.

As a result, according to a competent French observer, in 1910 American railroads carried four times as many ton-miles of freight per capita of the population as did French and German roads at half the cost per ton-mile, and transported the average American citizen 31 per cent further than French roads carried their nationals, and 3 per cent further than German roads carried theirs at about twice as great cost per passenger-mile.[4]

"In Europe," says Mr. Colson, "civilization developed before the period of easy transport, so that production had to be organized in such a way that each district should, as far as possible, supply itself; while in America farming and industries started nearly everywhere simultaneously with the railroad. Each district could devote itself to producing those articles for which its soil, its subsoil and its climate rendered it most suitable, the facility of long-distance exchanges thus making it possible to subdivide the work among the different parts of the territory."

Concerning this the American observer has to comment that what Europeans regard as civilization includes a lot of inhibitions on farming, industry, and the long-distance exchange of commodities. Further, that it is by no merit of intelligence on the part of present-day Americans that our civilization is free from some of those inhibitions, yet it is a very happy form of civilization and we are

[4] C. Colson, Inspector General of French Highways and Bridges, in the Railway Library for 1912, Stromberg, Allen & Co., Chicago, 1913, at page 21. Correcting the passenger-miles by adding three ciphers and recalculating the units, the data came out thus:

		Millions		*For each unit of population*		*Cents of cost for each*	
	People	Passenger-miles	Ton-miles	Passenger-miles	Ton-miles	Passenger-mile	Ton-mile
United States	92	32,312	199,983	351	2,171	1.94	0.85
France	39.5	10,564	18,455	267	467	1.08	1.37
Germany	65	22,059	30,578	339	470	0.91	1.41

grateful to our ancestors for handing it to us.

It is interesting to see the same good fortune of the United States cropping out—without any reference to railways—in the comment in 1927 of the Managing Director of the German General Electric Company, Privy Counselor Deutsch, after a tour in America. "While the German General Electric Company is compelled to produce thousands of articles of special design to suit the wishes of its customers at home and in other European markets, its parent firm in America deals with a clientele familiar with the same business practices and having identical tastes. . . . A vast public that wears collars of the same pattern, cravats of the same color, and garments of the same cut naturally calls for the same kind of electrical appliances." (*The Living Age*, Jan. 1, 1928, page 11.) Mr. Deutsch exaggerates, it seems, but we get his point.

On the northern Great Lakes and throughout the South occur interruptions of the railweb, at barren or mountain lands that resist development or transit. Little backwoods occur every here and there in these regions where one can get far from the railway and old fashions prevail.

Toward the west a transition of streaming parallel lines leads to a great railnet in Canada, the United States, and Mexico throughout the plateau country. The backwoods are large, rough mountain masses, most difficult to cross. In four favored basins, the Valley of California, Salt Lake, southern Idaho, and eastern Washington, little railwebs are beginning to develop, but for the most part the railnet is typical and fairly uniform. The towns occur, of course, on the railways. I believe there is now no town of ten thousand people that is off the line, but the interspaces are not so much of backward people as regions without inhabitants.

Cuba has a net of her own.

Railway tentacles are flung from the North American railnet into the Peace river country and Alaska (beginning here at the sea). The very straight-flung tentacle from Manitoba toward Port Nelson, like the shorter one from Cochrane near James Bay, seeks to take out the prairie grain in the short open season by Hudson Strait. Within the western railnet many a short tentacle invades a little valley.

In Alaska and again in Central America and Mexico, traffic is from the sea inland. The appearance of transportation down from Arizona through Mexico into Central America is illusory. Traffic that way lacks interchangeable wares, but if it existed it would compel the closing (it is now closed, June, 1928) of the gap between Tepic and Guadalajara at once, as it is represented closed on many inaccurate maps, notably the great European atlases.[5] It is beside the only bay on the west Mexican coast. Similar gaps occur along the west coasts of Central America. In all these regions traffic is from the sea inland. What appear to be longitudinal and main lines are merely minor connections between these lines from the coast.

[5] I think our railway map of Latin America is complete for 1927, thanks to the critical labor of Mr. Raye Roberts Platt, Editor of the American Geographical Society's Millionth Map of Latin America. That of Africa is taken from the Statesman's Yearbook of 1927. That of the United States from the Map by the General Land Office at Washington. For others, a great variety of authorities has been consulted. Incidentally, it is a great pleasure to note the accuracy of Goode's Atlas and Dennoyer and Geppert's Wall Maps (dated!) in the matter of actually existing railways. Most atlases and school geographies are full of errors in the matter.)

South America has a railweb on the Argentine Pampa of about a hundred thousand square miles area, extending across a fertile plain from the Atlantic to a boundary of aridity in the west. Three widths of gauge have undoubtedly hindered its greater

FIGURE 5.—South America within ten miles of the railway. Note the *riverlinks* of Colombia and Brazil.

expansion. Two incipient webs occur at São Paulo and Rio in Brazil. Half of the Pampa, still cattle country, has only a net of rails and most of the country about Rio and São Paulo is covered by a railnet. Tentacle lines reach into the interior in many directions, notably from São Paulo to Corumbá just north of Paraguay and from the Atlantic coast of the Argentine westward across Patagonia toward the Andes, lower there for a passage to Chile and with well-watered lands at their eastern foot. Brazil has a dozen such tentacles from the coast, not often penetrating deeply. So has almost every country in the continent. Internal commerce they largely lack. They exchange their raw products with factory wares from Europe or North America and their railways respond to this need. In some cases the tentacles from the sea have been connected up. Thus the through connection between Montevideo and Rio Janeiro consists really of links between the ends of these tentacles from the sea. Through bookings of either passengers or freight are the exception.

It looks from such a map as this as if one could buy a ticket in Buenos Aires for Cuzco, Peru, but this is not the case. The Argentine has a railway from the sea to Jujuy and this has been extended to and beyond La Quiaca into Bolivia. Bolivia has two lines from the Pacific with ports at Arica in the bend of the west coast and Antofagasta further south, both now in Chile. Though these two are connected together they carry mainly traffic between the Pacific and the Bolivian interior. So the main line of Southern Peru is from Mollendo by Arequipa to Puno and Cuzco. It is the tentacular part of the lines from the sea inwards that always carries the bulk of the goods. Northern Peru has nothing but tentacles, without connections between, and there is little demand for connections. Chile has what appears to be a superb development of longitudinal railway the length of the country, but quite illusory. It looks as if you could travel from Iquique to Puerto Montt, but you cannot buy a ticket for Puerto Montt even at Santiago except in the tourist season of January and February. To the northward through travel hardly exists. One

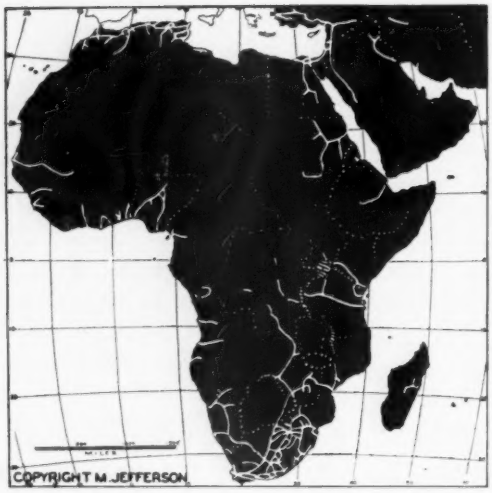

FIGURE 6.—Africa within ten miles of a railway.

goes to a point up the coast by steamer and inland by rail, as the products of the country go out to the sea by rail.

River links are represented by the Railway around the falls of the Madeira, just north of Bolivia, bridging from the water traffic of the upper to the lower Madeira. The Amazonian wilderness is served almost exclusively by its rivers. Columbia has its links from Bogotá to the Magdalena and from the Magdalena to the Cauca, eastern Brazil a link between Theresina on the Parnahyba and Caxias on the Itapicurú, in the province of Maranhão, and one around the falls of Paulo Affonso on the São Francisco in Alagoas and Pernambuco, both near the northeastern corner of the continent.

There is much room for more railway building in this continent. If the Amazonian country is to be exploited from its uplands rather than from its river banks as Roy Nash predicts, it will be served by tentacle lines from eastern Brazil.

Africa has railnets in the Atlas and in the Union of South Africa. In most of the country the development is tentacular, seeking to penetrate the hinterlands from the sea and getting above the falls that isolate the upper river navigation. The Congo has three or four river links just south of the middle of the continent. There is certain to be much new building in this continent, but some of the plans for lines across the desert may find the motor car a better solution of their need.

Australia is better supplied. A well-developed railnet in the southeast serves South Australia, Victoria, and New South Wales, with beginnings of railweb in the country north of Melbourne. A smaller railnet in West Australia is connected to the east by the Transcontinental line across the desert. For the rest the scheme is tentacular as in all new lands. The lines have already penetrated well into the desert on many sides. Possibly motor transportation will serve most further needs in

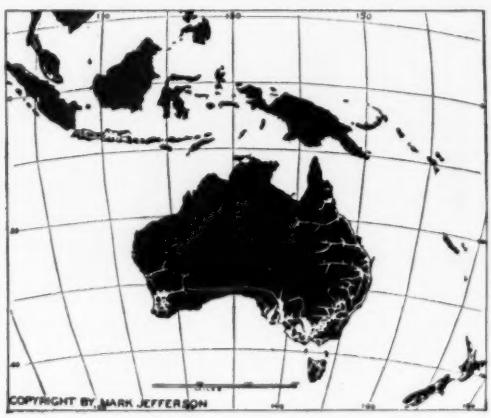

FIGURE 7.—Australia within ten miles of a railway.

that direction. The humid part of the island is fairly well supplied with rails. New Zealand to the southeast and Java to the northwest have each a well-developed railnet corresponding to their high development, while the great tropical islands—Papua,

Celebes, Borneo, and Sumatra—as yet have almost no rails. The Malay peninsula has a considerable development. It is likely that the large islands will yet see much railway built.

Asia, as the greatest unbroken land mass, has greatest need of land transportation, offered in part from time older than history by its great rivers. The two great accomplishments of the continent are the railnets of India built by England, and that of Japan by herself, the only oriental country that has put her shoulders to self-development on the most approved occidental lines. There are still two backwoods of Asia greater than any others in the world except the Saharan. Nothing could put England's contribution to the civilizing of India in a clearer light than this map of the Indian railnet with its thickening in the valley of the Ganges.

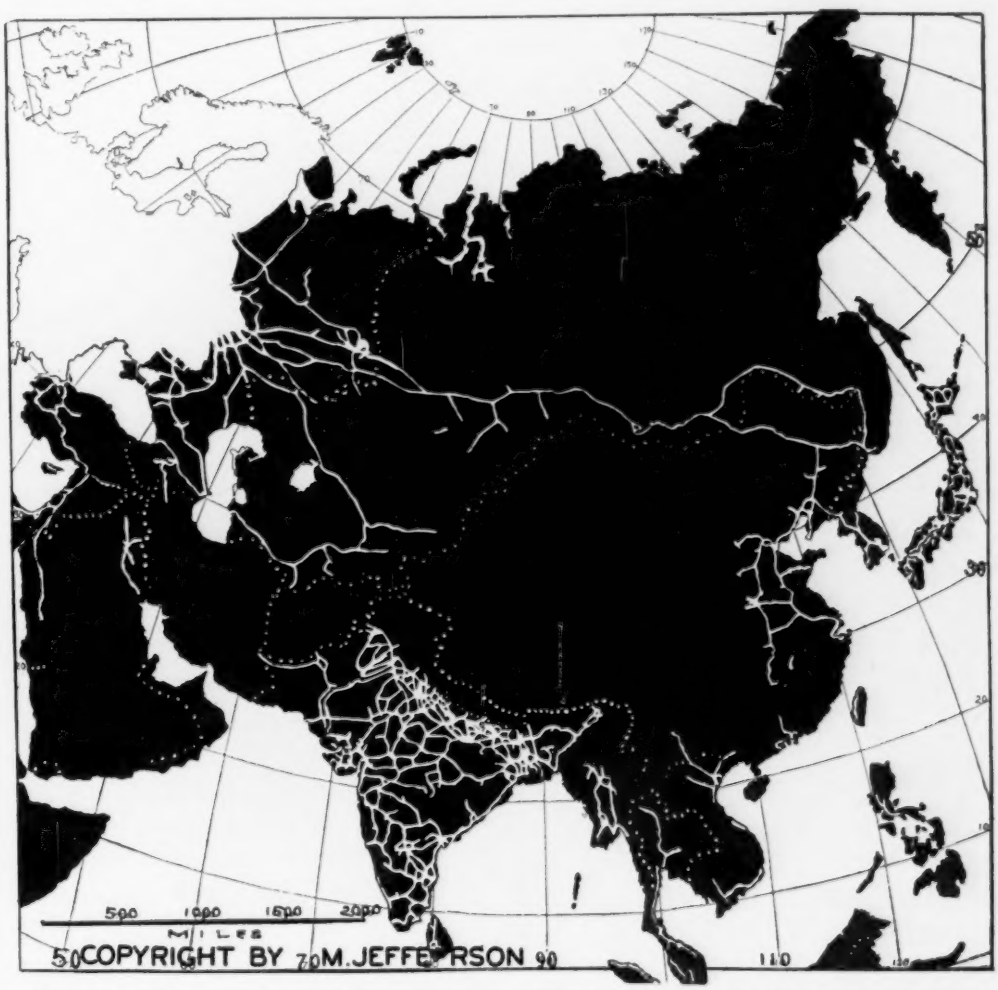

FIGURE 8.—Asia within ten miles of a railway. The most suitable situation for a *railweb* is in China, where as yet only a beginning of a *railnet* has been made and this based apparently on Japan.

The entry of Russian culture into the continent is evident in the three great tentacles from the northwest, reaching down toward the Hindoo Koosh on the one hand and closely

margining the Chinese domain on the north, with tentacles aimed at it in various points. The connection with the South Manchurian Railway, which is in the hands of Japan, with a bridge of lines through Korea, suggests willingness on the part of Japan to supply the culture that shall develop the railnet already incipient on the plains of eastern China.

Though Afghanistan has no railways the Transcaspian from Krasnoyarsk has a branch from Merv ready at the frontier to push into Herat and another from Khiva ready to advance the longer distance to Kabul, while the English, skirting Afghan territory just as closely on the south, have a branch from Quetta on the Baloochistan line flung out to the frontier towards Kandahar and another from Peshawar on the side of Kabul, all with an air of readiness to go when wanted.

Persia is entered by the Baloochistan line as far as Duzdab, and by a Russian line from the Caucasus as far as Tabriz, west of the Caspian Sea, and has its own little line from Bushire on the Persian Gulf to Borazjan, tentacular all. Besides these is the railhead from Baghdad on the side of Iraq, which fails of connecting with Europe by the gap from Nisibin to well south of Mosul, the line along which Imperial Germany was pushing toward the east when war came. The long tentacle from Anatolia into Arabia to Medina, built by the Turkish faithful as a religious pilgrim route from the domain of the Sultan who claimed the headship of the Moslem world to its holy city Mecca, fails at both ends, and its middle part, far withdrawn from the sea to be out of the reach of British warships, is now in British hands in Transjordania.

River links are in evidence in China, connecting Nanchang with Kiukiang on the Yangtse and south of Omsk in Siberia where one connects Kamenong Kopi with the nearest point on the Irtish, for in this most backward continent, river travel is all important.

It is of some interest to compare

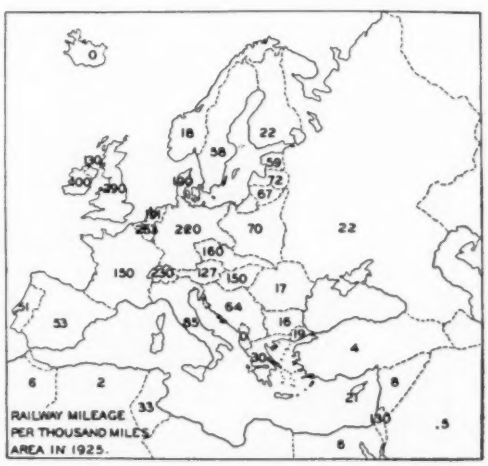

FIGURE 9.—Europe's mileage of railways per thousand square miles of area in 1925.

statistics of railway mileage with these maps of nearness to the rails. For comparison between countries the author takes the mileage for each thousand miles of area, using the data for 1925 from the Statesman's Yearbook of 1927.[6] The countries of the

[6] Some editing had to be done. France seemed to have less rails than before the war until it was noted that she now reports only "principal lines." Her figure 25,808 miles should probably be about 33,000. Belgium has apparently added in her "local lines," which may be what are elsewhere reported as "trams" and "electric lines." These are not counted here, on the assumption that they are part of the city conveniences rather than of transportation about the country. Possibly not a sound view and very likely some countries do not distinguish in their data.

The author has made an attempt to estimate the Russian figures and the Turkish figures separately for European and Asiatic territory, calling the Russian railways in Europe 39,104 miles, in Asia 7,151, and the Turkish 208 miles in Europe, 1,965 in Asia. Areas, also not well-defined, the author has called for Russia in Europe 1,774,000 square miles, 6,412,144 in Asia. The Turkish areas, 11,000 miles in Europe and 483,500 in Asia.

European railweb have the following mileages per thousand miles area: Britain 290, Belgium 263, Holland 191, Denmark 190, Germany 220, Czechoslovakia 160, Hungary 150, all over 150. Turning to the United States the states in the railweb are Massachusetts 262, Connecticut 204, Rhode Island 164, New Jersey 308, Pennsylvania 283, Ohio 207, Indiana 263, Illinois 215 and Iowa 177, again out in the country. A threefold allowance is needed to cover this irregularity.

The Swedish figure, 58, is a proper average for a country half in and half out of the railweb. If we could get figures for the separate parts of the country we should doubtless get over 150 for the south and something like the Norwegian figure for the north. Thus the United States as a whole

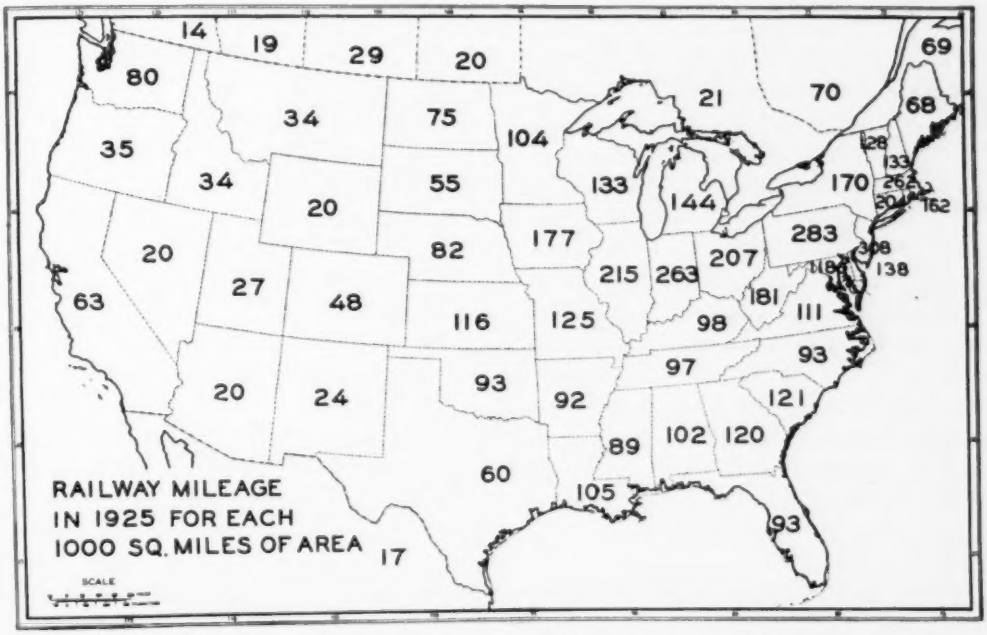

FIGURE 10.—United States' mileage of railways per thousand square miles of area in 1925.

all above 150. We may take 150 miles of railway to a thousand miles of area as the railway density that introduces the railweb.

Fifty miles of railway, with its twenty-mile-wide strip, covers exactly a thousand square miles of country. Fifty miles to the thousand then would be enough, if the tracks were everywhere spaced at exactly equal distances, to produce a railweb. That we really need 150 means that the tracks are actually very irregularly spaced, with a great crowding at every great city and much thinning has 87 miles of railway to the thousand square miles of area, but the North alone has 137, the South 91, and the West 37. Or taking nine divisions as the United States Census does, we find a variation from 221 in the North Atlantic states to 29 in the Mountain division. Australia, with a general railway density of 9, has 53 in Victoria and 5 in West Australia. The figures for the Canadian provinces are all small because of the large unsettled areas in the north, notably Ontario, the peninsular part of which lies in the railweb, although its

mileage is 21 per thousand. Nova Scotia and New Brunswick, being without these empty northern spaces, have better figures of 69 each. Morocco and Algeria similarly, including great desert spaces on the south in their official area, have 6 and 2 miles respectively, while Tunis, cut off from the desert by the Italian boundary, has 33. The same thing is illustrated in every part of the world. For this reason a real comparison of the provision with railways of the settled part of any country should be rated by the settled, not the total, area.[7]

Italy has 85 for its figure, much like Tennessee, Arkansas, Mississippi, and Alabama. The author has put the *interrupted* railweb at 75 miles to the thousand, an insufficient excess over the 50 miles that would just fill out the territory with 20-mile-wide white bands, if the roads were spaced with geometrical evenness. Hence the spattering with little backwoods.

The Spanish and Portuguese figures, 53 and 51, the Russian at 22, and the Balkan ones at from 16 to 64, like Mexico with 17 and the North American West, ranging from 20 to 75, suggest a lower limit for the railnet of fifteen miles per thousand miles of area. A symmetrical network of railbands twenty miles wide, if there were 15 miles of rails to a thousand square miles of area, would enclose interstices seventy miles on an edge. At fifty miles, as has been stated, there would be no gaps between the lines unless they were uneven.

Americans are naturally concerned to know the future of railways in the United States. The United States has been aptly called a railway-created country (Herbert Quick). Railways here enabled men to carry civilization, a civilization that was undoubtedly European, into what had been a trackless wilderness and create there that widespread prosperity which has recently been revealed to Europe to arouse astonishment—and other sentiments! It is not that the railways happened to come along just as the country was being settled. The country did get settled then because the railway was available to do the work. Without the rails there would be no such country today. Settlement would have crept slowly along the rivers; numbers would still be small and wealth far less. Canals would be more numerous and fewer of those once built would have fallen into decay. All the waterways would be in use but the total movement would be by our present lights insignificant. The railways made the United States and the present generation has its whole life tied up with the effects of railways. The present is the moment to survey the geographic aspects of railway development for the reason that signs abound that a new epoch is about to dawn or has already come.

The presence of more than twenty million automobiles on surfaced roads, already half as extensive as our railway mileage, cannot but impress the observer with the fact that great masses of passengers and freight are now definitely moving without much regard to the railways. The Class I railways of the United States carried a peak traffic in 1920 of 46.8 billion passenger-miles. In 1926 it had fallen to 35.6 billion. Freight, it is true, showed no decrease. It was 410.3 billion ton-miles in 1920 and

[7] This was done in the writer's study of the "Culture of the Nations," 1913, which used each country's mileage of railways per hundred miles of *inhabited* area.

443.9 ton-miles in 1926. The increase, however, is only a fourth as rapid as in the previous six years. Before the great war we had been building railways in the United States at the rate of four or five thousand miles a year. Our maximum mileage was 254,000 miles in 1916 and it is believed to be four thousand less in 1925, that is of road actually in use. These figures accord too well with what we see going on all about to be in doubt. Had we summer figures, when the automobile goes farthest afield, we should see greater differences, at least as far as passenger traffic is concerned.

What will the outcome be? In undeveloped countries railways can in many cases render service at less expense than it costs to maintain passable roads. This is especially true in humid regions. In desert or semi-desert regions motor transport appears to have points of great advantage over the railway. In Spain in 1927 motors carried passengers in every direction across the "backwoods." In this connection, it is worth noting that the United States had about 46 per cent of the world's total mileage of railways in 1890, 43 per cent in 1900, the same in 1910 and 38 per cent in 1920. As Europe's mileage too has fallen from 34 per cent of the total in 1905 to 31 per cent in 1925, it appears evident that the remaining third of the world's railways, the railways of the less developed regions, are now increasing mileage more rapidly than are those of Europe or the United States. In populous countries, as more roads are built and more motors manufactured, more people and more goods will take to the roads. The railways will presently have to content themselves with carrying freight which is from its nature unfitted for transport in small units, and passengers under conditions so much more agreeable than the railroads offer today that some who could travel by car would actually prefer to travel by train. It is quite possible that future new building of railways in the United States and Europe may be in good part offset by taking up unprofitable lines, and that in densely peopled regions, where highway building is not beyond the means of the inhabitants, there may yet be a considerable shrinking of present railway mileage.

PIEDMONT NORTH CAROLINA AND TEXTILE PRODUCTION

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Geographer, University of North Carolina

PIEDMONT North Carolina, that portion of the state lying to the west of the Sand Hills region and extending to the foot of the Blue Ridge Mountains is made up of a broad rolling peneplain, with here and there monadnocks standing out in relief. It may well be divided into two areas, the eastern or industrial and farming area; the western a resort section. The general elevation is from 300 feet in the east to about 2,000 feet at the foot of the Blue Ridge Mountains. In the eastern area are found some of the very best farm lands within the state. Here, cotton, tobacco, corn, and the small grains are the main crops.

The western part of the section is in general mountainous in character, the general trend of the elevations being northeast and southwest. In the west, farm lands of value are scarce. At most places the land is rough, stony, and the slope of the land too steep for good farming. Fruits, corn, and the small grains make the average crop.

The drainage in the west is taken care of by the Yadkin, Catawba, and the Broad Rivers. In the upper reaches, the Yadkin and Catawba Rivers flow east, later bending sharply to the south, entering the Atlantic Ocean through South Carolina. In the falls of these rivers and their tributaries is found a tremendous water power. In the east, the drainage is for the greater part through the basins of the Cape Fear, Neuse, Tar, and Roanoke Rivers. Here, again, we find a source of hydro-electric power in the falls which occur where the streams flow from the older crystalline formations on to the more easily eroded material of the recently uplifted Coastal Plain. The power plants of most importance are located at or near the fall-line.

The statistics according to the 1925 survey are as follows:

TABLE I

EASTERN PART OF THE SECTION, NEAR OR AT THE FALL-LINE

	Horse Power
Blewetts Falls, Anson County	32,150
Buckhorn Falls, Lee County	3,350
Roanoke Rapids, Halifax County	8,800
Carbonton, Moore County	1,200

Aside from the power plants mentioned, there are numerous places on the eastern streams at which 500 horse power may be generated.

In the western part of the section, power plants are numerous and located as a rule where the streams from the mountains reach the lower hill country.

TABLE II

WESTERN PART OF THE SECTION

	Horse Power
Badin, Montgomery County	124,000
Narrows of the Yadkin, Montgomery County	20,000
Mountain Island, Gaston County	80,000
Lowell, Gaston County	1,000
Lockport Shoals, Catawba County	33,000
Idols, Forsyth County	1,800
Mt. Airy, Surry County	1,000
Rhodhiss, Catawba County	45,000
* Bridgewater, McDowell County	33,000

* Sayville and Smith.

Here, again, there are a great many small power plants. This tremendous amount of natural power has, without question, been a vital factor in the manufacturing industries of the state. However, at the present

time, natural power is not had as cheaply as one would be led to expect. In the higher altitudes, and close into the mountains, there is an unusually heavy rainfall. In counties such as Gaston, Rowan, Mecklenburg, and Catawba the rainstorms are decidedly cyclonic in character, giving an average precipitation of 46 to 48 inches. Thunderstorms are of frequent occurrence, but there is no record of a tornado resulting in the loss of life.[1] The months of greatest rainfall are July and August, and least in October and November.

FIGURE 1.—Dairy cattle grazing on Fall sown cover crop, Wake County, North Carolina. The North Carolina Piedmont has become one of the most progressive and prosperous regions of the country.

In the area, especially close into the mountains, there are several facts worthy of notice. As mentioned above, in the higher altitudes there is an unusually heavy rainfall. Under normal conditions, this storm water would be stored in the ground and there would be a steady flow of the streams throughout the year. However, man, in his methods of taking the products of the forests, has, in many instances, stripped the land of its natural covering. As a result, where there should be a natural reservoir, the run-off is fast. On account of this, in times of drought, water-power decreases rapidly. Cost of reservoir, maintenance, and other factors make continuous power come at a high rate. Floods, while not particularly dangerous, are ever on the increase. Then, too, the streams are offering an ever intermittent source of power. Normally, throughout Piedmont North Carolina, there is not a stream of any size in which the waters are clear. This points to one conclusion: rapid run-off brings silt and fine particles of mud into the streams, which, in a comparatively short time causes the sedimentation of the reservoirs. The inevitable result must be the expense of new and higher dams, the cost of which is naturally passed on the operator.

The mean temperature for the Piedmont area is 58.6 degrees. Table III gives data for representative stations.

TABLE III

TEMPERATURE DATA, PIEDMONT NORTH CAROLINA *

	Mean	*Highest*	*Lowest*	*Length of Record*
				Years
Marion	57.5°	103°	−10°	29
Charlotte	60.2	102	−5	44
Salisbury	60.1	103	−1	32
Greensboro	58.8	104	−3	24
Lincolnton	58.5	103	−2	16

* U. S. Department of Agriculture.

It is to be noted that in this central area, although partially protected

[1] U. S. Department of Agriculture.

FIGURE 2.—Cotton picking scene in North Carolina. Though not so prominent a factor in the agriculture of the state as formerly, it still is an important cash crop.

from the cold land breezes, every part has at times experienced temperatures as low as zero. January is the coldest month, although February is a close second, and on the whole more disagreeable.

"Nearly every part of the area has a record of 100 degrees for the months of June, July, and August. However, this is the exception, and there are records of few days during which the temperature has reached 95 degrees."[2] There is one fact especially worthy of notice. There is a considerable day to day and day to night change in temperature. To people living here, this has an invigorating effect. In brief, work is more of a pleasure, not a drudgery.

As regards the climate of Piedmont North Carolina there are certain conclusions which may well be kept in mind:

1. An area in which the climate is mild, yet due to frequent changes and cyclonic storms, is invigorating.

2. With abundant rainfall, and with proper care, streams affording sufficient power go a long way in manufacturing.

3. There is a very long growing season.

[2] U. S. Department of Agriculture.

HUMIDIFICATION

Today it is a well-known fact that wherever textiles are manufactured, artificial humidifiers must be used. This is somewhat contrary to the old idea of first the people of the British Isles, and later of the New England States. In the early days it was thought, particularly in England, that the natural humidity was quite sufficient for the average work. Should such have been true it is quite certain that textile plants on any large scale would not have been built in Piedmont North Carolina. Quite truly the Department of Agriculture shows Charlotte as being in a region of 70 per cent relative humidity. But, it must be remembered, that the

FIGURE 3.—Ginning cotton in North Carolina. The ginning season is a busy time, when the farmers reckon their gains or losses for the season.

data giving this figure were taken at 8:00 A.M. and at 8:00 P.M., and in no way represent a fair average for the working hours of the day. The average relative humidity during working hours is 40 to 45 per cent.[3] In passing, it may be mentioned that textile plants are not moving to North Carolina because of natural relative humidity. On the other hand, as compared with the manufacturing districts in New Eng-

[3] W. B. Hodges, Vice President, Parks-Cramer Company.

FIGURE 4.—Farmers storing cotton at warehouse, Cleveland County, North Carolina, well toward the western part of the state.

land, the difference in relative humidity in the North Carolina region is so slight as to be negligible.[4]

When textile manufacturing was started in North Carolina the absence of natural humidity was supposed to be a great handicap. It has been found that in England, as well as in the New England States, the mills are artificially humidified. Under the most extreme conditions, the wet and dry bulb readings shown by a sling psychronometer, gives New England only two points advantage in relative humidity. Piedmont North Carolina is in the 20 degree depression belt, somewhat less favorable from a climatic manufacturing standpoint than New England. But, estimates of required humidity take into account many factors aside from actual humidity. Contributing conditions are the location of the individual mill; the goods manufactured; the horse power developed; the number of operatives per square foot and the building con-

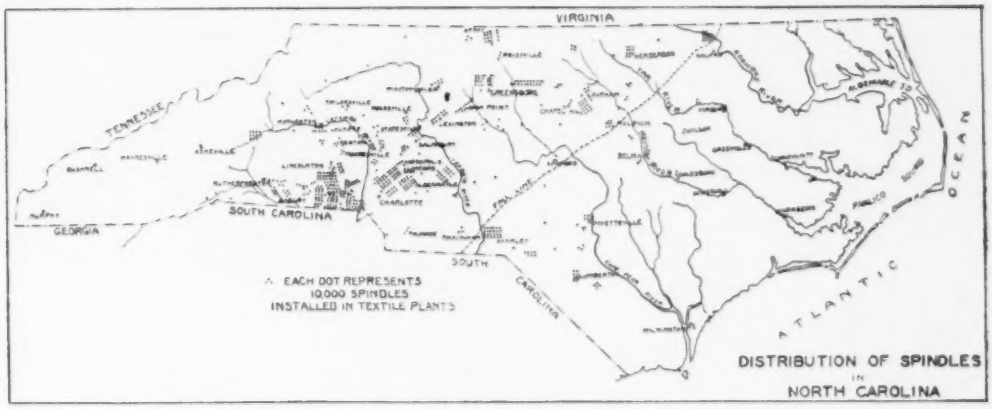

FIGURE 5.—The distribution of spindles in North Carolina according to data of 1926. In the past two years, the number has increased considerably.

[4] W. B. Hodges, Vice President, Parks-Cramer Company.

FIGURE 6.—Erwin Cotton Mills Nos. 1 and 4, Durham, North Carolina. Combined spindlage, 75,000 or more. There are upwards of 1,000 looms of ordinary width, and more than 1,000 broad looms.

struction. When properly considered a large number of factors, such as just enumerated, have quite as much, if not more, to do with the artificial humidification required than do the climatic conditions alone. Then, too, on account of the more moderate temperature, the region under consideration is more favorably situated for the use of humidifiers.

As mentioned above, the amount of humidity needed for manufacturing depends upon the goods wanted. Below is given a table showing approximate humidity necessary for the different operations in the manufacture of textiles.

TABLE IV

	Per Cent
Carding	45–50
Roving	50–60
Spinning	60–65
Weaving	75–95

In regard to humidification, certain facts are apparent: (1) As the elevation decreases, humidification must increase; (2) all plants of importance must be equipped with artificial humidifiers; (3) the area is most favorably situated for the use of artificial humidifiers; and (4) the more favorable winter conditions in North Carolina more than offset the summer conditions in New England.

GROWTH OF TEXTILE PLANTS

Though not of any great importance, textiles were manufactured in North Carolina as early as 1828. Among the oldest plants are those located at Rocky Mount, Tarboro, Fayetteville, and one in Lincoln County. During the same year meetings were held at Greensboro, Salisbury, and in Iredell County for the purpose of arranging for the manufacture of both cotton and wool. It may be mentioned that in this year the balance of trade was $10,000,000 against North Carolina. The question was often asked, Why should North Carolina buy her flour in the North, pork in New York, or hogs in Kentucky and Tennessee? Cotton

FIGURE 7.—Erwin Auditorium, Durham, North Carolina, given by W. A. Erwin to his employees. The auditorium is the center of all community work.

FIGURE 8.—Directed play among the children—a scene typical of the better class mills in North Carolina, and indicative of the social status of the mill communities.

and tobacco were the only products exported from the Piedmont section of the state. The introduction of manufacturing systems and railroads was the remedy. In 1828 the state shipped 80,000 bales of cotton at $2,400,000, which if manufactured would bring $9,600,000, a gain of $7,200,000. It was suggested that manufacturing plants would afford occupation, stop immigration and build towns. Among the names which stand out in this movement is that of John Motley Morehead.

The following gives the location and date of founding of the textile plants in North Carolina:

1810 Lincolnton, Rocky Mount, and Great Falls.
1820 Greensboro.
1830 Leaksville and Graham.
1840 Belmont, Fayetteville, Randleman, and Saxapahaw.
1850 None.
1860 None.

FIGURE 9.—Street scene in one of the mill villages at Greensboro, North Carolina—one of the Cone group of mills. Life is calm and contented about these villages.

1870 Burlington, Ramseur, and Laundale.
1880 Durham, Saxapahaw, Worthville, Concord, Kannapolis, and Burlington.
1890 Durham (2), Belmont, Roanoke Rapids (2), Albemarle (2), Spray, Greensboro (2), Concord, Kannapolis (2), Brookford, Lincolnton, Reidsville, Wake Forest, Elizabeth City, Sanford, Franklinton, and Charlotte.
1900 Marion, Gastonia (3), Winston-Salem, Mayodan, Kinston (2), Durham (2), Tuxedo, Raleigh, Forest City (2), Cherryville, Lincolnton, Lenoir, Lexington (2), Pomona, Shelby (2), Lumberton (2), Thomasville, Cliffside, Avondale, Hanes, Charlotte, Marion, Landis, St. Pauls, Smithfield, Monroe, Kings Mountain, and Graham.

1910 Cramerton, Stanley, Lexington (3), Roanoke Rapids, Winston-Salem (2), Gastonia (5), Tarboro, Ranlo, Lumberton, Valdese, Bladenboro (2), Greenville, Shelby, Lincolnton, Maiden, Red Springs, St. Pauls, Biscoe, and Granite Falls.
1920 Monroe, Mt. Holly (2), Gastonia, and Granite Falls.

It must not be thought that in the early days the South was a slow and backward division of the nation. One hundred and twenty-five years ago the industrial development of the South was as much advanced as that of any part of the Union. The census of 1810 shows that the manufactured products of Virginia, the Carolinas, and Georgia exceeded in variety and volume those of all the New England States taken together.[5] When the Union was formed, North Carolina stood third in wealth and population. However, a change was soon brought about. This was due to the institution of slavery—not the negro. As slavery gained, commerce and manufacturing declined. And finally, when the war between the states began, the state, as well as other southern states, was almost entirely dependent upon other parts of the country for its existence. Such a condition was of short duration. The people soon learned to work. It was during the latter part of the reconstruction period that the textile industry gained its feet. Once started, it was not to be easily stopped.

[5]Tompkins, A Builder of the New South.

FIGURE 10.—Revolution Cotton Mills, Greensboro, North Carolina—one of the Cone group of mills—illustrative of the post-war industrial development of the region.

LABOR

In the early Reconstruction days there was a keen local pride, and a necessity for using the natural resources so abundant and so close at hand. This pride was shared not only by those who conceived the idea and furnished the limited capital, but by the people who worked. There was not, and there is not today, the class consciousness known in other large industries. It was a case of "one for all" and "all for one." Such a condition exists largely at present. As the industry grew, more laborers were necessary. Just here entered that source of labor which has ever since been the reservoir—the peoples of the mountain districts of the Southern Appalachian and the "poor white" tenant farmer. The mill communities offered advantages to which these people had never been

accustomed. The laboring class of people are of purest American stock, with less than 1 per cent foreign born. At present, to the people in the mills, New England is almost like a foreign country. That there is a marked contrast in wages is of little concern. A wage of $3 a day in a North Carolina mill is equivalent to $6 in New England.

LIVING LESS EXPENSIVE

In North Carolina at least 80 per cent of all mill workers live in villages owned by the mill. In the state the average charge for a house is $1 per room per month. The average size of a house is four rooms. Thus for $4 per month, the operative is given a house which includes all costs for electric light, water, and sewerage. The mill villages are as a rule on the outskirts of small cities, such as Greensboro. The lot on which the house stands is as a rule sufficiently large for a garden, and many families keep a cow. The grocery bill is thus reduced. Coal, which is a small item, is sold to the operatives at cost. In this way $226.72 is added to the wage of each worker.[6]

MODERN MILLS

For the greater part, the mills of the state are modern and equipped with the very best machinery. In a mill that is kept up to date there is a general satisfaction among the men and women operating the machinery. Few vexations and what the operatives term "good running work" is the rule. It is nothing but human nature. According to Mr. Edmonds, when all runs along smoothly there is much efficiency attributed to "good running work."[7]

[6] R. W. Edmonds. Manufacturer's Record, 1926.
[7] *Ibid.*

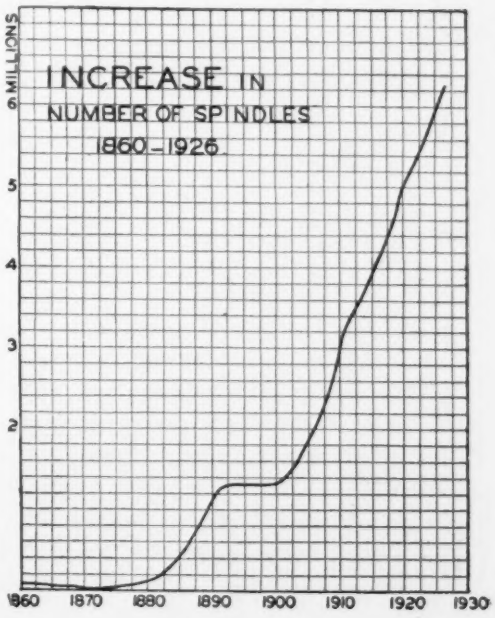

FIGURE 11.—Graph shows number of spindles operating. Note the decline following 1860; the relative standstill, 1890–1900; and the continuous advance in the years following.

GETTING AHEAD

A factor which seems important is the idea of "getting ahead." The help in the North Carolina mills, as has been noted, is almost wholly American, born of American parents. Formerly, among the operatives, ambition was rare, and the will to rise more rare. Today this is not wholly true. Many mill owners have schools conducted to teach the girls and young men. The idea of individual improvement and individual effort is almost innate in the mill people. It is being developed just as rapidly as possible by the mill owners.

WELFARE WORK

Among the small mills little is done for the help. A man and his family take their lot as they find it, and seem content. But where there is a large mill one is sure to find the owner doing all possible for the people who

work for him. Below is given a rough estimate of the funds spent by an owner of a large mill during one year.

Schools	$25,000
Nurses	5,000
Welfare Department	15,000
Y. M. C. A.	25,000
Dairy (milk at cost)	3,000
Landscaping	8,000
Village Upkeep	10,000
Village Water	9,000
Village Light	3,000
Home Farm	5,000
Total	$108,000

There were 2,000 operatives. The mill owner invested approximately $54 for the direct benefit of each one of his operatives.

SUMMARY

(1) In the early days the textile industry in the South had its beginning because of the ingenuity and foresight of a few men far ahead of their times. (2) Later, the industry was crippled because of the war and the institution of slavery. (3) At first the location of water power sites helped in locating the mills. (4) The influence of climate resulted in (a) excellent living conditions, (b) lower cost of living for operatives, and (c) invigorating effects of daily changes. (5) Welfare work is going ahead rapidly.

LOCATION FACTORS IN THE IRON AND STEEL INDUSTRY

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THE factors determining the location of the iron and steel industry have never been adequately studied by geographers or economists. General observation, however, long ago led to the simple statement, "Iron moves to coal," perhaps the most commonly held principle in the whole field of economic geography. Recent discussions of "Pittsburgh plus" and of the problems of the Ruhr have given this principle a wide publicity. This simple statement portrays fairly accurately the general situation in the iron and steel industry of the United States, Canada, Great Britain, Sweden, Spain, and Japan and, if certain cases can be regarded as exceptions, it may be accepted as a fair "rule of thumb."

The purpose of this paper is to show that this rule, though generally accepted, has not been adequately explained, to point out its limitations, and to offer tentative hypotheses to account for, and supplement, the general rule.

Explanation of the Rule

The common explanation for the rule is almost as simple as the statement itself, and nearly as well known; namely, that "it takes two (or 'several') tons of coal to smelt one ton of iron ore." That this statement offers a satisfactory explanation is clear; it would obviously cost much more to ship two tons of coal than one ton of ore. That this explanation appears to explain so simply the movement of iron to coal is probably the reason for its general acceptance by the public as well as by nearly all teachers of geography, including the authors of most text books on economic geography. Investigation of the facts, however, shows that the explanation is unsatisfactory because it is not true.

Authoritative statements in encyclopedias, metallurgical texts, and official reports, both of the industry and of the United States Census, checked by questioning competent authorities in the steel business, show clearly that it does not require two tons of coal (in the form of coke) to smelt one ton of ore, but rather somewhere between a half ton and one ton, depending on the proportion of iron in the ore and the chemical character of the ore. Taking account of the amount of coal required to produce a given amount of coke by present methods, the figures shown in Table I indicate the amounts of coal and ore required to smelt one hundred tons of pig iron from the ore, in different regions. In every case a greater amount of ore than of coal is required—in certain cases, where low-grade ore is used, practically twice as much. The additional small amount of coal used for power —less than four tons per one hundred tons of ore—is practically offset by the power or heat developed from the blast furnace gas and used in other parts of the steel mill.

But one text in geography was found in which these facts concerning

TABLE I

ORE AND COAL CONSUMED IN PIG-IRON PRODUCTION IN SELECTED DISTRICTS OF NORTH AMERICA AND EUROPE[1]

	Pig Iron	*Ore*	*Coke*	*Coal*[c]	*Per Cent* Iron in Ore	*Per Cent* Coke in Coal	*Ore*	*Coke*	*Coal*	*Coal per Ore*
	In thousands of tons						Per 100 tons pig iron			
Alabama[a]	2,088	5,535	2,870	.....	38	65.4	265	137	210	79
Indiana-Illinois[a]	4,822	9,051	4,430	.....	53	72.5	187	92	127	68
Pennsylvania[a]	11,919	21,636	11,870	.....	55	66.2	181	100	150	83
United States[a]	30,097	57,000	30,850	.....	53	67.4	189	102	151	80
United States	30,097	55,000	30,850	.....	55	67.4	183	102	151	83
Canada	837	1,641	990	.....	51	[d] 66.7	196	118	177	90
England and Wales[b]	8,891	22,889	.....	18,651	39	....	258	...	210	81
Scotland[b]	1,361	2,819	.....	2,573	49	....	206	...	188	91
Great Britain	10,260	23,954	.....	21,224	41	....	234	...	207	88
Ruhr	8,214	17,000	.....	12,610	49	....	207	...	154	74
Belgium	2,485	6,860	2,663	.....	36	76.6	277	107	141	51
Pays de Calais	933	2,731	.....	1,494	34	....	292	...	160	55
Saar	1,375	3,384	2,019	.....	41	[d] 65.8	246	147	224	91
Luxemburg	2,548	8,514	2,886	.....	30	[d] 76.6	334	113	147	44
Lorraine Annex	3,870	12,820	5,300	.....	30	[d] 73.0	331	137	186	56
French Lorraine	3,493	10,485	4,075	.....	33	[d] 76.6	300	117	152	51
Tot. Lorraine	9,911	31,820	12,260	.....	31	[d] 75.1	324	124	164	51

[a] Figures for ore corrected to include equivalent of scrap purchased and mixed with ore.
[b] Figures for ore include mill cinder, etc., not included in totals for Great Britain.
[c] Coal used in form of coke: statistics for coke not available. These figures may be a little too high.
[d] Estimated from various sources.

the smelting of iron were stated in anything even approaching the correct figures. In that text, however, consideration is not made of the fact that the making of pig iron is but the first step in an industry in which fuel is required at every step until the finished products—rails, beams, plates, wire and others—are ready to be sold to the user.

To convert 100 tons of pig iron into steel requires fuel amounting to 35–50 tons of coal.[2] The total amount of coal required, therefore, to convert ore into steel in the United States is about 200 tons per 100 tons of crude steel.[3] Additional fuel is required for power in the production and further manufacture of steel, varying greatly in amount according to the nature of the product.

The actual consumption of fuel and other materials in the steel industry in various sections of the United States and in Belgium is shown in Table II.[4] If we assume that no old scrap was used in steel

[1] Statistics for U. S. and Canada are for 1919; for Europe, for 1913. Tonnage figures for U. S., Canada, and Great Britain represent gross tons of 2,240 lbs. each; those for districts on the continent of Europe represent metric tons of 2,204.6 lbs. each.

Compiled from:

U. S. Census of Manufactures, 1919, Vol. X, pp. 315, 316, 320, 321.

U. S. Geological Survey: *Mineral Resources of the United States, 1920*, II, p. 370.

Annual Statistical Report of the American Iron and Steel Institute, 1919 (New York), pp. 91–92.

Great Britain, *Report of Imperial Mineral Resources Bureau on Iron Ore* (London, 1922), Part I, p. 210.

U. S. Geological Survey: *Bull. 703. Iron and Associated Industries of Lorraine, etc.* (1920).

Leith, C. K.: "The World Iron and Steel Situation," *Foreign Affairs* (New York), Vol. I, 1923, p. 136.

Porter, Horace C.: *Coal Carbonization* (New York, 1924), p. 90.

[2] The fuel used in the steel furnace is usually artificial gas produced from coke or bituminous coal of varying grades, but may also be natural gas or vaporized oil. Natural gas is the ideal fuel, and the large supply of natural gas in the Youngstown-Pittsburgh region has been a particular advantage to the steel industry there.

[3] This proportion is commonly expressed by ironmasters in the statement: "It takes two tons of coal to produce one ton of steel," a very different thing it should be noted from "two tons of coal to smelt one ton of ore."

[4] This table does not include the fuel consumed in foundries which treat pig iron to produce finished iron products, but which are scattered over the country nearly as widely as the ultimate markets.

TABLE II

RAW MATERIALS, FUEL, AND PRODUCTS OF BLAST FURNACES AND STEEL MILLS IN UNITED STATES AND BELGIUM[1]

	U. S.	Ala.	Ill.-Ind.	Penn.	Belgium	U. S.	Ala.	Ill.-Ind.	Penn.	Belgium
	In thousands of tons					Per 100 tons pig iron				
	Gross tons				Metric					
Blast Furnaces:[a]										
Total Ore equiv.	57,000	5,535	9,051	21,636	.....	189	265	187	181	...
Ore	55,000	4,963	8,860	20,756	6,860	183	238	183	174	276
Scrap	1,058	216	102	486	.....	3	10	2	4	...
Flux	13,820	633	1,763	6,080	.....	46	30	36	51	...
Coke	30,850	2,870	4,430	11,870	2,662	102	137	92	100	107
Coal equiv.	45,600	4,380	6,110	17,900	3,504	151	210	126	150	141
Pig Iron prod.	30,097	2,088	4,822	11,919	2,485	100	100	100	100	100
Steel Mills:						Per 100 tons steel products				
Total Raw Iron	29,274	1,019	5,325	12,652	.....	108	121	111	104	[c] 115
Pig Iron	24,363	1,019	4,464	10,526	2,829	90	121	93	87	115
Scrap	4,911	0	861	2,126	.....	18	0	18	18	...
Ore	1,052	[c] 50	209	567	.....	4	6	4	5	...
Total Products	27,032	846	4,797	12,143	2,467	100	100	100	100	100
Finished Steel	25,513	689	4,307	12,143	2,115	94	81	90	100	86
Crude Steel	1,519	157	490	0	352	6	19	10	0	14
Total Fuel[b]	32,477	1,101	3,928	16,443	.....	120	130	82	135	...
Coal[b]	24,869	978	3,230	12,310	1,263	92	116	67	101	51
Oil[b]	1,698	16	279	771	.....	6	2	6	6	...
Gas[b]	3,627	7	19	2,720	.....	13	1	0	22	...
Blast Furnace Gas	2,283	[c] 100	[c] 400	642	.....	8	12	8	5	...
Total Industry:						Per 100 tons all products				
Total Ore equiv.	67,320	5,585	10,860	26,050	.....	205	291	211	192	...
Ore	56,052	5,013	9,069	21,323	.....	171	261	176	157	...
Scrap	5,969	216	963	2,612	.....	18	11	19	19	...
Flux	13,820	633	1,763	6,080	.....	42	33	34	45	...
Fuel (coal equiv.)[b]	78,077	5,481	10,038	34,343	.....	238	286	195	253	...
Total Products sold	32,766	1,915	5,155	13,536	.....	100	100	100	100	...
Finished Steel	25,513	689	4,307	12,143	.....	78	36	83	90	...
Crude Steel	1,519	157	490	0	.....	5	8	10	0	...
Pig Iron	5,734	1,069	358	1,393	.....	17	56	7	10	...

[a] Coke furnaces only.

[b] Equivalent in bituminous coal, gross tons, on the basis of 5 bbls. of oil, or 25 m. cu. ft. of gas, to a ton. Allowance made for blast furnace gas used.

[c] Estimated.

production, but only iron ore, and that all the ore was made into finished steel products, the amount of ore and coal necessary to produce 100 tons of steel products in the different districts would be approximately:

	Ore	*Coal*
United States	208	283
Alabama	326	384
Illinois-Indiana	212	222
Pennsylvania	193	291
Belgium	318	213

The quantity of coal consumed in Belgium is probably somewhat below the correct figure. That for Illinois-Indiana presumably reflects the higher efficiency of the modern plants in the South Chicago-Gary district. We may summarize these proportions roughly by stating that: It requires between one, and one and a half tons of coal to convert a ton of iron ore into steel products in the United States; in Belgium, about three quarters of a ton; in Lorraine, probably about one ton.

The conclusions with regard to the old explanation of the movement of iron to coal, which rested on the large consumption of coal in smelting ore are: first, it is an incorrect statement of the facts; second, it is notably incomplete; and third, when corrected and completed it does not present an adequate explanation of the general rule of the movement.

Nevertheless, the rule itself can be shown to hold in most parts of the

[1] Statistics for U. S. are for 1919; for Belgium, for 1913.

Compiled from:

U. S. Census of Manufactures, 1919, Vol. X.

U. S. Geological Survey: *Bull. 703. Iron and Associated Industries of Lorraine, etc.* (1920), p. 93–103.

U. S. Geological Survey: *Mineral Resources of the United States, 1920*, Vol. II, p. 370.

world: the industry is generally located in or near the coal fields. There are, however, very important exceptions, the study of which throws light on the factors underlying the rule itself.

In North America important steel plants, including blast furnaces, are found removed from coal fields in Duluth and Sault Ste. Marie, the South Chicago-Gary district, and southeastern Pennsylvania. As Appalachian coal is used for coking in each of these districts, the South Chicago-Gary district is geographically as remote from the coal fields as are the Lake Superior plants, and is also as remote from the ore fields as are Buffalo and Cleveland, places much nearer the coal.

In Europe similar exceptions are found in Italy, Austria, Spain, and Lorraine. The situation in Lorraine is most significant. Statistics[6] compiled by the United States Geological Survey, as well as those compiled by Leith, show that of the iron ore produced in these fields in pre-war years—in French Lorraine, German Lorraine, and Luxemburg—66 per cent was consumed in blast furnaces within the same district and only the remaining third shipped out to the coal fields of the Saar, northwestern

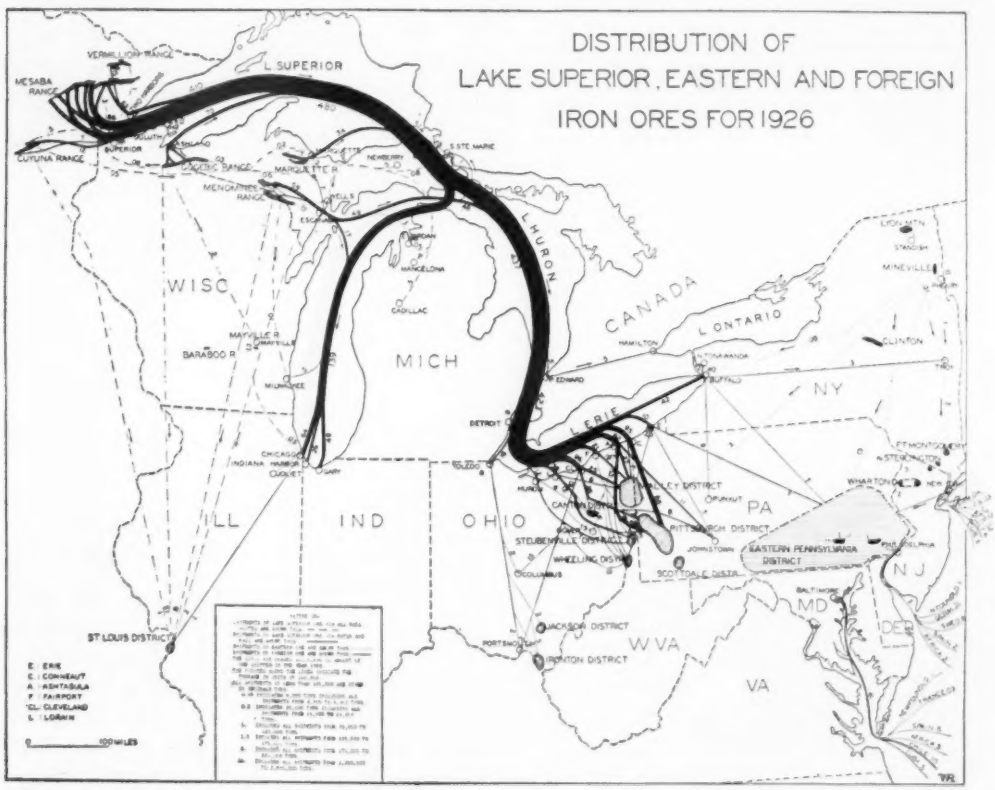

FIGURE 1.—The movement of iron ore, the routes, quantity, and destination are all well presented on this chart. The relative importance of the various centers of production and manufacture, their distance from consuming areas, and their areal distribution illustrate the intricacies of the problems of price and rate adjustment. (Courtesy of Lake Superior Iron Ore Assn.)

[6] U. S. Geological Survey: *Bulletin 703. Iron and Associated Industries of Lorraine, etc.*

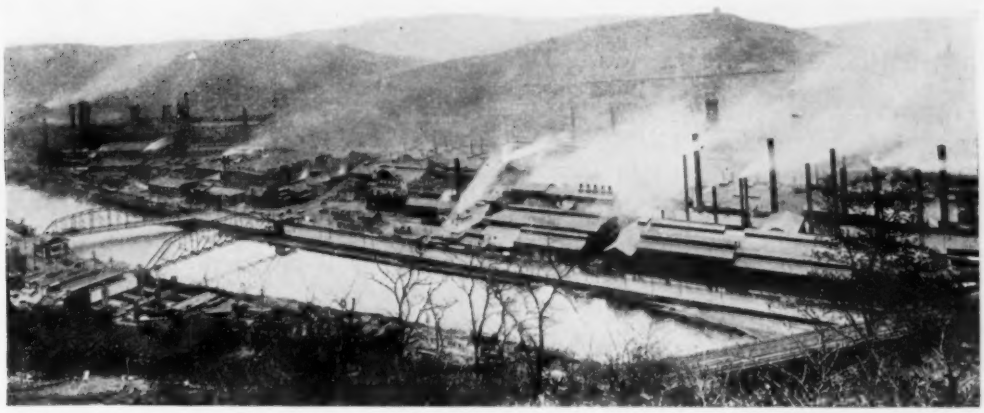

FIGURE 2.—Part of the Cambria Steel Plant at Johnstown, Pa., in the heart of the bituminous coal region of western Pennsylvania. In this region, as in many others, steel plants are universally situated along streams partly because rail routes follow the stream valleys, but primarily because of the vast amounts of water required in the industry. (Courtesy of Bethlehem Steel Corp.)

France, Belgium, and the Ruhr. Imports of coal[7] from the same fields amounted to nearly as great a tonnage as the ore exports. (Comparison of the figures for the different portions of the area indicate that the political situation was of little importance.) In particular, the shipments of ore to the Ruhr was notably less than the receipts of coal from the Ruhr. The explanation for this exceptional situation rests on the fact that smelting the low-grade Lorraine ore requires only half a ton of coal per ton of ore.

FIGURE 3.—The Lackawanna Steel Plant at Lackawanna, N. Y., near Buffalo, is situated within the great market region of eastern United States. This plant is placed not within, but near, the coal fields in order to eliminate the trans-shipment of ore from lake to rail. Like various plants at other lake points, this plant has largely developed its own port and harbor facilities. (Courtesy of Bethlehem Steel Corp.)

However, the statistics of the Lorraine industry further show that

[7] Whether this coal is shipped to the ore region and there converted into coke or the coke is produced in the coal mining area and shipped in that form is a minor factor. In the United States coking coal is commonly shipped to the industrial district where it is to be used and is there made into coke because of the greater loss from breakage in transporting coke. In Western Europe apparently the reverse is the case, for reasons not as yet ascertained.

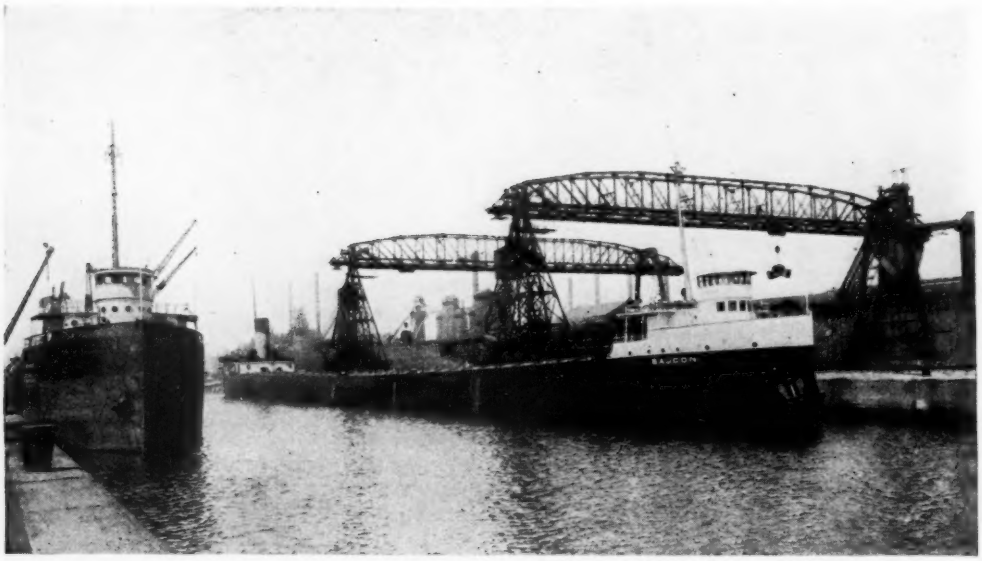

FIGURE 4.—Lake shipping facilities at Lackawanna Plant, Lackawanna, N. Y. Ore is being unloaded from the boat on the right, while steel cargo is loaded in that on the left, for shipment to Chicago and other lake ports. Since the entire eastward movement of ore from the Lake Superior district is carried by lake vessels, Buffalo and Cleveland are geographically as near the iron-ore mines are as Chicago and Gary. (Courtesy of Bethlehem Steel Corp.)

much of the pig iron produced in the Lorraine ore district is not, as is general in the United States, converted into steel in adjacent plants, but is shipped as pig iron, to the steel mills in each of the four coal fields mentioned previously. In 1913, nearly half of the output of pig iron was shipped out, of which about two-thirds was apparently received by the mills in the Ruhr. What is the explanation of this movement? As

FIGURE 5.—General view of the Maryland Steel Plant, Sparrows Point, Md., about 10 miles from Baltimore. This, the only steel plant in the United States located at tidewater, receives foreign ores by sea from Cuba and Chile, Appalachian coal both by rail and by rail-and-water, and ships its products not only by rail throughout the market region in which it is located, but also by water direct to coastwise and overseas markets. The layout of the plant in response to these conditions may readily be seen. (Courtesy of Bethlehem Steel Corp.)

the amount of coal required to convert pig iron into steel products is much less than the amount of pig iron treated, it is clear that the deciding factors in this case are not those of relative costs of transportation of the raw materials. It is concluded that the deciding factor is the cost of shipping the finished products to markets within the great adage overlooked—the cost of shipment of the finished products to the ultimate market. The significance of this cost has been pointed out more recently by Mr. Spencer of the United States Geological Survey, but no demonstration of its importance in comparison with the other factors has been attempted. A complete analysis of the conditions influencing

FIGURE 6.—Coal storage and coal handling equipment, Maryland Plant, Sparrows Point, Md. Middle Appalachian coal reaching tidewater at Norfolk and Newport News, is cheaply brought by Chesapeake Bay barges directly to the storage yards. Somewhat similar equipment is used by some of the steel plants in the Chicago district and by the plants at Milwaukee and Duluth to unload Appalachian coal brought by lake boats. (Courtesy of Bethlehem Steel Corp.)

Westphalian district and to markets with respect to which that district has the better location.

A somewhat similar situation is found in one district in the United States—the Birmingham, Alabama, district—which, producing both ore and coal in much greater amounts than are required for the local steel markets, ships out 50 per cent of its pig iron production to steel mills in other districts (Table II).

These two examples of production and movement of iron emphasize the third principal factor which the old

the location of the iron and steel industry is yet to be made. For the advancement of the science of economic geography, such an analysis is greatly to be desired.

As a basis for investigation a number of tentative hypotheses are proposed. Of these the first two or three are probably acceptable without further proof, but the others require careful demonstration. The first six hypotheses have to do with factors which are assumed to be of minor importance in influencing the general location of the industry,

though certain of them determine the particular site of the plants within given areas.

1. *Limestone* for fluxing exerts a minor influence on the location of the steel industry because it is used in much smaller amounts than other materials (Table II) and it is more generally distributed.

2. Since water is used in the iron and steel industry in larger amounts than any other raw material excepting air, *surface water*—streams and lakes—is the most important factor determining the specific site of steel plants within a region (Fig. 1). This may even prove a factor limiting increase, as in some places in eastern Ohio, but, because of the abundant supply of surface water in most areas in which the steel industry might reasonably be developed, it is seldom, if ever, an important factor influencing the general location of the industry.

3. *Land* for the plant and land—or water—for the disposal of waste, though of major importance in determining the exact site within a limited area, exert little influence on the general location of the industry.

4. *Labor* is only a minor factor influencing the location of the steel industry, excepting under unusual conditions of climate, standard of living, or economic development.

5. *Capital* and *taxes* are usually of slight importance in affecting the location of the industry.

6. Under conditions of free competition the *fixed investment* in plants located in the past under different conditions can offset only for a limited period superior natural advantages of other locations.

The remaining four hypotheses are concerned with stating the major factors, their relative importance, and their relation to each other.

FIGURE 7.—Group of four blast furnaces, Maryland Steel Plant, Sparrows Point, Md. The raw materials, ore, coke, and limestone, are carried to the top of the furnace and there charged, by machinery, into the furnace, where the hot blast burns the coke at a high temperature; the limestone causes the ore to melt at a relatively low temperature, the burning coke reduces the oxide ores to nearly pure iron, as impurities are carried off in the limestone slag. The third product, chiefly carbon monoxide gas, was formerly allowed to escape into the air in picturesque flames, but is now collected and used, partly to pre-heat the blast, and partly to supply power used in other parts of the plant. (Courtesy of Bethlehem Steel Corp.)

7. The three major factors affecting the location of the steel industry are relative location of areas producing iron ore, of areas producing coal (especially coking coal), and of areas consuming the finished products.

8. All of these three factors are of nearly equal importance; but the third, which we may call the "market factor," is of somewhat greater importance than either of the others. While it requires over two tons of coal to produce a ton of steel products—in the United States—the freight rates on the products are generally more than twice those of coal; the minor factor of scrap, purchased largely from consumers, may be added to that of finished products, making it more important than coal—or ore.

9. The significance of ore and coal varies to some extent with the char-

FIGURE 8.—Part of the Bethlehem Steel Plant, Bethlehem, Pa.—blast furnaces in the background, steel works and rolling mill in the foreground. This plant was originally located close to the anthracite coal fields, local ore mines, and the seaboard markets, but remains today on the basis of the same markets, imported foreign ores supplementing local ore, and coal or coke brought from the Appalachian coal field several hundred miles away. (Courtesy of Bethlehem Steel Corp.)

acter of the finished product, but to a greater degree with the chemical nature and "grade" of the ore, the ore factor being more important with low-grade ore, and the coal factor more important with high-grade ore.

10. In most cases iron moves toward the coal fields, owing in part to the large amount of coal used in the industry, but to a greater extent because the largest markets for the greatest number of steel products are usually developed in or near the coal fields.

These hypotheses may be tested by both of the methods commonly employed in scientific study. The first method is to make a detailed accurate study of those facts which concern the production of iron and steel of which the more general and approximate study so far made has led to these hypotheses, in order that they may be the more firmly established, or if found incorrect, the correct ones may be established. The second method of testing the hypotheses is to deduce from them by logical reasoning various theorems concerning the location of the steel industry and compare these with the actual situation in the world today.

For example, from what has been assumed of the importance of ore, coal, and markets, it follows that wherever any two of these coincide in the same area the iron and steel industry should be developed in that district, provided only that the other be available in an area not too remote, and, of course, that there be no special and insuperable difficulties with regard to the other minor factors mentioned. Furthermore, if these three are found in separate areas situated along, or near to, a geographically direct route of transportation, the industry should, with certain exceptions, be developed in or near the middle area, whether that of coal, ore, or markets.

Some of the actual situations which should develop are given in the

following theorems, each of which will be illustrated by one or two examples.

1. Where the three areas chiefly concerned—the ore-producing area, the coal-producing area, the market area—coincide (approximately), the steel industry is developed within the common area. The best known example of this in the United States is the Birmingham, Alabama, district; the conditions are found also, in large part, in the Cumberland (Liverpool-Manchester) district in England.

2. Where the coal and ore areas are adjacent or coincide, the industry develops close to or within the common area, in proportion to whatever market can be served from there. This situation differs from the first type in the absence of important local markets. It is found most strikingly at Sydney, Nova Scotia, where large resources of raw materials near at hand have led to the development of a steel industry greatly limited because of the lack of markets. The Pueblo district in Colorado is, to some extent at least, another example of this sort.

3. Where the market area coincides with the coal area (and ore areas are accessible) the steel industry develops in the common territory drawing the ore to it. This, perhaps the most common type of situation, is found in Westphalia where Ruhr coal and the large local market attract ore from Lorraine and Sweden; and in the Pittsburgh district where similar advantages account for the vast movement of ore from the Lake Superior district. A special modification of this rule is necessary: in case of low grade ore, the larger part of it is smelted in or near the ore fields by coal drawn from the outside, the product being shipped as pig iron to the "coal-and-market" area. The best example of this is found in the relation between Belgium and Lorraine.[8] A test case will be provided in the future with the development of the low-grade ores of Minnesota.

FIGURE 9.—The Cornwall Iron Mine, Cornwall, Lebanon County, Pa., is the largest producing iron mine in northeastern United States. This mine supplies much of the ore used in the largest iron and steel plants in eastern Pennsylvania. (Courtesy of Bethlehem Steel Corp.)

4. Where the market region coincides with the ore area, the steel industry is developed there, drawing coal to it. The steel industry of Lorraine, insofar as it is dependent on nearby markets, is an example of this situation. A clearer, though less important, example is offered by the steel industry of Italy, which depends on local markets, ore from the island of Elba, and Welsh or Westphalian coal.

5. Where the market lies between the coal fields and the ore fields and at no great distance from a direct route between them, the industry is

[8] Modifying factors involved in this case are the high lime content of the ore and its porosity, facilitating smelting.

located within, or close to, the market area. The best example is the steel district at the head of Lake Michigan (South Chicago-Gary), where ore from Minnesota and coal from West Virginia are brought together to produce the steel for the great market region of which Chicago is the capital. Another example is furnished by the modern steel industry of southeastern Pennsylvania and Maryland where foreign ores from Cuba, Spain, and other areas are smelted with bituminous coal, brought several hundred miles from the west, to supply the seaboard markets.

6. Where the coal area lies between the ore fields and the market region, the industry develops in or near the coal fields. The steel industry in the Saar coal field, lying between the Lorraine ore district and the markets of northern and eastern Germany, is an example of this situation. Insofar as the Cleveland-Pittsburgh region is dependent on seaboard markets, it also comes under this head.

7. Where the ore area lies between the coal fields and the market region, the industry develops in or near the ore fields. Naturally but few cases of this sort will be found. The small steel industry at Lake Superior ports, Duluth and Sault Ste. Marie, established to supply the markets of Canada and northwestern United States, furnishes one example. Another is found at Bilbao, Spain, where Welsh coal smelts local ores to supply Spanish markets.

FIGURE 10.—The Hanover Limestone Quarry, Hanover, Adams County, Pa., supplies the requirements of the Maryland Steel Plant at Sparrows Point, Md., about 50 miles distant. Limestone quarries to supply blast furnaces are dependent in their location on the location of the blast furnaces, rather than the reverse. (Courtesy of Bethlehem Steel Corp.)

Several theorems might be formulated concerning the shiftings and new developments in the industry which result from changes in any of these three factors, but which lag behind and are much less gradual than the changes which cause them.

Particularly by this means may be tested the validity of the hypotheses which assume such factors as labor and fixed investment to be of but minor importance.

CONCLUSION

A satisfactory analysis of the factors influencing the location of the iron and steel industry is by no means simple, but will require a careful, detailed study of the facts with regard to the industry in many parts of the world, including, in particular, the following: (1) the movement of ore, coal and coke, pig iron and steel, to and from the more significant iron- and steel-producing districts of the world; (2) the amount of the various raw materials required in the industry, and of its finished products, based on statistics which are quite complicated and require checking with figures secured from representative companies in the industry; (3) the actual freight rates affecting the transportation of the commodities concerned; and (4) the labor costs in comparison with transportation costs.

THE OZARK ORCHARD CENTER OF SOUTHERN ILLINOIS

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TWO distinct commercial orchard centers, differing widely in geographic conditions have been developed in Southern Illinois. One orchard region has developed on the rugged slopes of the "Ozarks," the name locally applied to the maturely dissected rocky bluffs and clay hills which extend across the river-girt extremity of the state and constitute the Ozark Ridge, a low plateau commonly described as an eastward extension of the Ozark Highland of Missouri. The ridge rises like an island detached from the main terrane by the Mississippi River (Figure 1). The other region, a hundred miles farther north, which extends eastward in a narrow belt through Marion, Clay, Wayne, and Jasper Counties, lies on an almost level terrane in a region of heavy, slightly acid soils.

The orchards which crown the Ozark hill tops have made that section one of the most important and promising commercial orchard centers of the state. Small fruits and vegetables find a favorable environment in the fertile valleys and are produced and marketed in large quantities. Because these two phases of the agricultural industry have different physical requirements, they do not usually compete for the use of the land or for the time of the farmer on the same farm. It is the purpose of the writer to analyze the geographic and economic factors which have operated strongly in the development of the commercial orchards of this small, but clearly defined, geographic unit.

EARLY DEVELOPMENT AND PRESENT STATUS OF THE FRUIT INDUSTRY

Horticulture has been an important phase of the agricultural development of the region ever since the first pioneers from the east and south settled on the forest-clad slopes. For over a hundred years the "Ozarks" have been known for the excellent flavor, quality, and size of its fruit. The settlers brought with them seedling trees which flourished in the favorable environment. These small orchards, planted in the early part of the nineteenth century, formed the nuclei of the present highly specialized commercial centers. The geographic conditions are suitable for all sorts of orchard fruits, but, from the first, the attention has been centered on the cultivation of the apple and the peach (Figure 2). The Winesap apple and the Elberta peach are the chief species grown and they reach a degree of perfection unequalled by any other part of the state and by only a few favored regions in the United States.[1]

While the orchard fruits have had a place in the agricultural economy of the region from the first, the era of commercial orchards is of relatively recent growth. In common with other commercial centers the industry has passed through several stages

[1] Folger, J. C., and Thomson, S. M., "The Commercial Apple Industry of North America," 1921, p. 398.

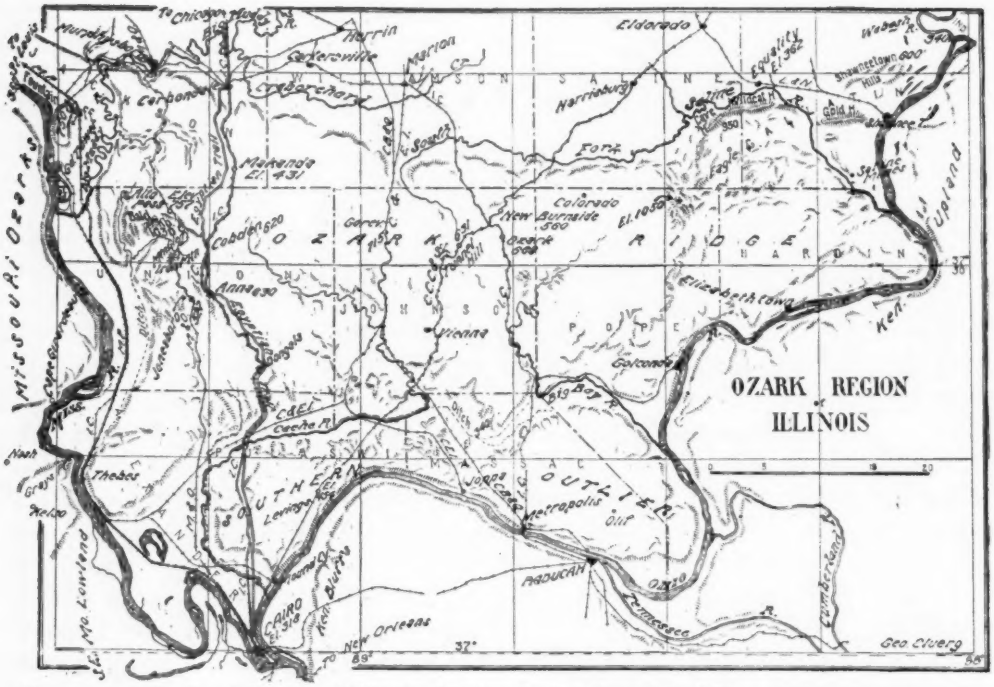

FIGURE 1.—The Ozark Region of Illinois, showing the location of the hills, or hill lands, surrounding lowlands, chief cities, and railroads serving the region. (George Cluerg.)

of development. It has had an early period of rapid growth (1854–1875), a period of decline (1875–1900), and a period of revival and expansion beginning with 1900 and lasting until the present time.

The stimulation to economic development that comes to a pioneer region when railroads provide cheap and regular means of marketing the products, is strikingly illustrated in the Ozark Region. The completion of the Illinois Central Railway in 1854 gave an impetus to the orchard industry which was followed by two decades of active planting, prosecuted with an enthusiasm, characteristic of youth. The extensive planting, however, was one of the chief causes of the decline later.

The first orchards were located on the north slopes of the Ozark Ridge adjacent to the railroad, extending from Carbondale to Anna-Jonesboro. Union County became the center and has maintained the leadership to the present time. The development in Johnson County came later and was co-incident with the building of the Big Four and Chicago and Eastern Illinois Railways through that section. In 1858 peaches were sent to Chicago and from that time on, the shipments grew increasingly greater.[2] The industry was sufficiently large to need a fruit train and in 1866 the Illinois Central Railway put on the first fruit special, the "first of its kind in Illinois and among the first in the United States."[2] Prior to this, carload lots attached to the regular passenger trains had facilitated the marketing of the fruit.[2]

The change from the farm orchard to the commercial orchard stimulated

[2] Colyer, F. H., "The Orchard Industry in the Illinois Ozarks," University of Illinois, Proc. of High School Conference, November 23, 24, 25, 1922, pp. 225–229.

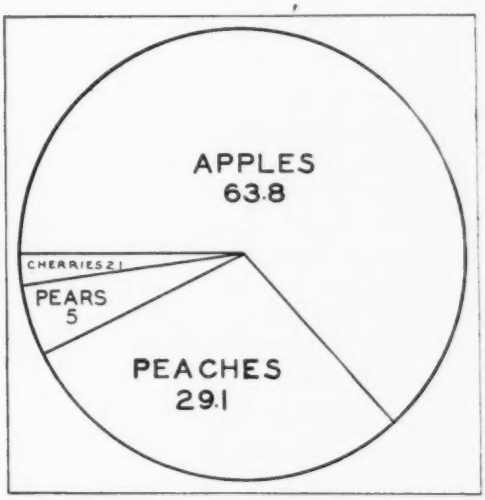

FIGURE 2.—The percentage of apple, peach, pear, and cherry trees of bearing and non-bearing age in the eleven counties of the Ozark Region of Illinois. (Census, 1919.)

many other industries in the region. The renovation of the old orchards of inferior seedling varieties and the planting of improved grafted fruits characterized the early stage of the commercial development in the Ozark Region. By 1857 several nurseries were established in Union County to meet this demand by the orchardists for better fruit trees.[2] The early development of the coöperage industry was in direct response to the demand for crates, hampers, boxes, and baskets for shipping the fruit. Since the region was originally forested, the raw material was at hand; the "soft woods," such as elm, sycamore, red and black gum, maple, cottonwood, and tulip trees were used in the industry.[3] As might be expected, the center of the industry was near the centers of fruit production—Anna, Jonesboro, Alto Pass, Dongola, and Cobden. The industry still persists, but as the timber has been exploited, local manufacturers are forced to bring lumber from Arkansas, Mississippi, Louisiana, and Tennessee. There is, therefore, a tendency for the industry to shift to the river towns.[3]

This early period of phenomenal development lasted until about 1875 when it suffered a decline. A number of factors, some geographic, some economic, operated in bringing about this change. (1) About this time several seasons of damaging freezes occurred which resulted in killing many of the peach trees.[4] (2) Markets were not sufficiently developed and in years of heavy production they were easily glutted. (3) Low prices prevailed as a result of the extensive planting and consequent overproduction. (4) The tendency for the surplus production of the widespread farm orchard to remain an important source for the local markets limited the market for the commercial crop. (5) The lack of scientific knowledge to combat the orchard pests and fungus diseases, which were exacting a heavy toll, proved to be a serious menace of no little importance.[4] (6) The development of the railways in the south and the use of the refrigerator cars brought the Ozark Region into competition with the commercial orchards and trucking centers of the south.[4] The region, therefore, lost its almost monopolistic hold on the northern markets and became one of a series of such centers, extending from the Gulf of Mexico to the Great Lakes.

As a result of these unfavorable physical and economic conditions many farmers turned into other lines of endeavor. The period of decline of the orchard industry was marked by a great increase in the production

[2] Colyer, F. H., "The Orchard Industry in the Illinois Ozarks," University of Illinois, Proc. of High School Conference, November 23, 24, 25, 1922, pp. 225–229.

[3] Miller, Robert, First Report of a Forestry Survey of Illinois, Bulletin No. 1, Natural History Survey, Urbana, 1923, p. 331.

[4] *Ibid.*, p. 227.

of small fruits. Trucking was not new in the region but had become strongly centralized in the fertile valleys of the southern slope of the ridge, especially in the vicinity of Villa Ridge. This section had long been noted for its luscious strawberries which were regularly marketed. Increasing amounts of strawberries, blackberries, raspberries,

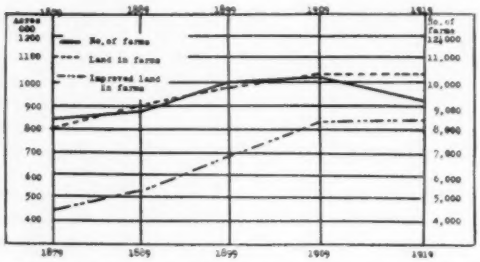

FIGURE 3.—Land in farms, improved land in farms, and number of farms in the Ozark Region of Illinois, 1879–1919.

asparagus, tomatoes, sweet potatoes, radishes, rhubarb, peas, and beans were now sent into the markets from the newly developed centers to the north, notably Anna, Jonesboro, and Cobden (Figure 1).

Since 1900 another advance in the commercial orchard industry has taken place. The growth has been slow but promises to be permanent. The control and change of certain factors which operated in the decline are those factors which have influenced the revival; namely, (1) the enlarged market as a result of (a) the general increase in population, (b) urban development and, therefore, a high percentage of people who do not raise the food they consume, (c) the recognition by an educated public of the value of fruit as an element in the diet, (d) a demand for high-grade fruit by a fastidious public which created a market for the scientifically grown product of the commercial orchards and reduced the market for the inferior fruits of the farm orchard; (2) improved cultural methods of spraying, cultivating, pruning, and fertilizing the orchards; (3) improved methods in picking, grading, and packing the fruit; and (4) the development of better organization for marketing the fruit which has tended to stabilize the industry.[5] The orchard industry has now grown from a desultory farm orchard to a highly specialized enterprise. Fruit has become the chief money crop in the region.

In 1919, the eleven counties of the Ozark Region reported 1,861,028 trees of bearing and non-bearing age, which was 17 per cent of the total number of the state[6] (Table I). Approximately 81 per cent of the number are concentrated in Union and Johnson Counties. In the last census year these two counties had 3,748 farms, 2,000 of which reported the production and 1,128 the sale of apples, while 1,350 reported the production and 748 the sale of peaches.[7] When we realize the relative insignificance of the declining farm orchard as a source of fruit, these figures take on new meaning.

TABLE I

ACREAGE AND PRODUCTION OF ORCHARD FRUITS OF THE OZARK REGION BY COUNTIES, 1919
(Census, 1919)

County	*Orchard Fruits* *No. Trees*	*Production* *Bushels*
Alexander	14,175	9,309
Gallatin	33,974	26,357
Hardin	34,486	19,750
Jackson	251,403	162,323
Johnson	407,674	145,729
Massac	39,574	25,752
Pope	94,137	37,777
Pulaski	56,284	41,358
Saline	99,994	80,071
Union	643,534	376,498
Williamson	185,793	26,357
Total	1,861,028	1,032,354

There is a tendency for the fruit industry to pass into the hands of

[5] Folger, J. C., and Thomson, S. M., *op. cit.*, pp. 9–14.

[6] U. S. Bureau of the Census, 14th Census, 1919.

[7] Figures supplied by the Dept. of Agr.

large companies, incorporated under the laws of the State of Illinois. The American Fruit Growers, Inc., with headquarters at Cobden, is illustrative of the tendency. This company operates five large orchards of 1,200 acres, 800 acres of which are in peaches.[8] A number of fruit growers own or manage orchards of 1,000 acres. In order to compete successfully with other producing regions, the modern commercial orchardist must use intensive methods and this involves large costs. The size of the farm is a factor of no little importance in determining the cost. The small land owner in the hill lands, unable to compete with the grain farmer on the fertile prairies to the north or with the large fruit producer in the region has sold his farm. In some cases he has moved into the coal mining districts to the north or has remained in the region and has been employed on the large fruit farms. The land in farms, the land in improved farms, and the number of farms in the Ozark Region for the forty-year period, 1879–1919, is shown in Figure 3. The trend towards the larger farms will be noted. During the last decade the land in farms and the improved land in farms has remained practically stationary, but the number of farms has dropped from 10,518 in 1909 to 9,134 in 1919.[9]

WEATHER AND THE FRUIT INDUSTRY

The climate of the Ozark Region is unusually favorable for the production of orchard fruits, but unfavorable seasons may and do occur. Temperature seems to be the most important climatic factor in influencing the location of the orchards and the size of the crop in any one season. It is especially significant in the period of bud development in the spring when a sudden freeze may ruin in one night a promising harvest. In order to lessen this danger the orchards are located near the crest of the ridge and on the northern slope. The slope position affords better air and soil drainage, and the northern exposure tends to delay the early bud development. Freezing weather is the greatest weather hazard of the section.

Because the broad prairies to the north afford no protection from the storms, the cold air may slip down over the plains and carry freezing temperature as far as the Gulf of Mexico. The anticyclones which bring this menace move southeast and leave the country either by the southern track or through the Ohio River valley. The cold air tends to settle in the lower valleys and ravines where the temperature is often two or three degrees lower than on the slopes; however, the slopes are not always secure from the freeze.[10]

The hazards in raising peaches are greater than apples because of the earlier blossoming habit. The average date for the blossoming of the peach ranges between March 25 and April 10, depending upon the weather conditions.[11] An unseasonably warm period may advance the buds as much as three weeks. This is exceedingly dangerous and the orchardist lives in a state of constant dread

[8] *Illinois Central Magazine*, "Southern Illinois is Noted for Its Fruit," October 24, 1924, p. 7.

[9] Census, 1919.

[10] Etherton, James, Carbondale, letter, 1926, "This year they (peaches) were killed in spots. The cold air and frost of the ravines and creek beds have killed the peaches in the valley and along the lower edge of the ridges."

Wilkins, Roy, Alto Pass, Illinois, letter, 1926, "If the weather gets as low as −10° F. the peaches will go. This year we had an unusual happening, in that the weather did get below −10° F. and the peaches were saved. The day before it turned so cold, ice covered the trees and it is thought that this ice protected the buds."

[11] *Op. cit.*

of the expected freeze. A temperature of −15° F. is fatal to peaches and the tree, therefore, cannot survive where this temperature is common. Anna, in the heart of the peach district, has a January and February average minimum temperature of 25.4° F. and 25.5° F. respectively; the lowest recorded at the station is −20° F. Such temperatures are rare, however. In the last ten years there have been two crop failures as a result of damaging temperature.[12]

Prolonged periods of rainy, cloudy weather in the critical spring season may be as great a drawback to a good harvest as freezing temperature by interfering with the pollenization and the spraying operations. The growth of fungus diseases is also favored by cool damp weather. However, such weather conditions, while not unknown, are rare. The maximum rainfall occurs in the spring and early summer (Figure 4); the precipitation is of the convectional type, characteristic of continental climates and is, therefore, of short duration.

The summer weather is almost ideal for the production of fruit. The ample sunshine insures a good color and the rich bloom of the Elberta peach and the luscious red of the Winesap apple are the result of this favorable climatic element. From 60 to 70 per cent of the days are clear during July, August, and September.

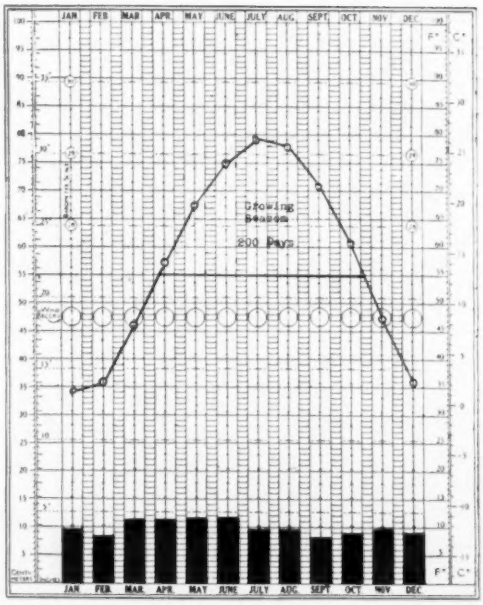

FIGURE 4.—Precipitation, temperature, and growing season for Anna, Illinois. Elevation, 682 feet. Anna is in the heart of the commercial orchards. It is located on the north slope near the crest of the ridge.

A cool, prolonged, dry fall is desirable for the harvest season. The peach harvest begins about August 11 and is completed by September 1. The Ben Davis apple is the last fruit to be harvested; the picking is begun and finished in October. August and September mark the driest part of the year (Figure 4); rainy, cloudy and windy weather do not offer serious handicaps to the harvesting season in this section.

The average date for the first killing frost in the fall is October 23. The apple harvest is practically completed, however, by this time.

INFLUENCE OF SLOPES AS SITES FOR COMMERCIAL ORCHARDS IN OZARK REGION

The orchards of the Ozark Ridge are well placed with reference to the slope of the land. Experience ob-

[12] The following estimates of the proportion of the crop harvested for the years 1915–1925 have been given to the writer by Mr. James Etherton of Carbondale, Illinois:

Year	*Proportion Harvested*
1915	Full crop
1916	Failure caused by severe winter
1917	⅔ of crop harvested
1918	⅔ of crop harvested
1919	⅔ of crop harvested
1920	½ of crop harvested
1921	½ of crop harvested
1922	Full crop
1923	Failure—low temperature in February
1924	Full Crop—bumper
1925	Full crop

tained in this region and elsewhere has taught that orchards do best when planted on sites which provide good air and soil drainage (Figure 5).

The commercial orchardist has taken advantage of the excellent sites afforded by the maturely dissected hills of the Ozark Ridge. In Union and Johnson Counties the orchards of Alto Pass, Cobden, Anna, Jonesboro, Ozark, Tunnel Hill, and New Burnsides crown the crest and extend down on the north slope. Such sites afford good air drainage; the cold air tends to settle in the lowlands at the same time the warmer air rises and retards the cooling on the uplands, while the high slopes are not absolutely protected from frost and freezes and hazards are much less on the clear cool night of spring. The orchardist is less likely to lose his crop and is, therefore, insured a more regular income from his venture. Horticulture is a highly specialized industry and the owner of such an enterprise should utilize every natural advantage in order that he might secure a fair return from his investment.

There are great possibilities for the extension of the orchards in Hardin and Pope Counties, where the northern slopes offer the same admirable sites as far as physical conditions are concerned. The industry has not developed here at the present time because of retarded transportation facilities.

The advantage of the slope position for orchard sites is still further seen in that it provides good soil drainage. Apple and peach trees differ from the date tree which, according to an old Arabian saying, "likes to have its head in the sunshine and its feet in the water." Fruit trees require considerably more water than is sometimes thought, but do not do well when the soil drainage is stagnant. The rainfall of the Ozark Region is approximately 40 inches but the subsoil is pervious enough for good soil drainage as the thriving condition of the orchards indicate.

FIGURE 5.—A well-placed orchard on the northern slope of the Ozark Ridge near Makanda, Illinois. (Courtesy of the Illinois Central Railway Company.)

While all of the important commercial orchards are located on the slopes, a few small enterprises remain in the valleys. But, here, for the most part, the farmers have given up fruit raising altogether, or have allowed it to become of secondary importance. During a favorable season fruit raised in the lowlands may yield

abundantly and thus supplement the farmers income; however, in most years, the production is precarious. Reports from this section indicate that all of the fruit of the lowlands has been seriously injured this year.

Grain farming and fruit farming are not usually carried out successfully on the same farm; one or the other suffers. The main dependence of the farmer of the lowlands is corn, hay, and alfalfa, and in some favorably situated valleys, small fruits and vegetables. The orchards, therefore, are neglected, and the quality of the fruit is likely to be inferior. The farmers who depend solely on fruit for an income, moreover, have commandeered the most advantageous sites and devote their entire time to the cultivation and care of the orchards.

SOIL OF THE ORCHARD SITES

Almost all of the orchards are grown on the yellow silt loam which constitutes about 70 per cent of the entire area of the hill lands.[13] The chief element of this type is the loess brought by the winds and left on the uplands, although the foothills of the northwestern part received a thin veneer of friable clay from the Illinois glaciation. The surface soil of the slopes varies in color from pale yellow to reddish brown, depending on the amount of organic material. Because of the color, the soil is called "clay land" but it does not show the characteristics of clay—when dry, it is loose and pulverant, porous, and easily worked; when wet, it is light and sticky like clay.[14]

As a result of eluviation the subsoil is a clayey silt, more compact than the surface soils, but not impervious to water to such an extent as to interfere with soil drainage. The soil drainage is not rapid but is sufficient as reflected in the healthful condition of the orchards. The commercial orchards have not expanded to include all of the well-drained sites. The soil is, moreover, pervious enough to allow for proper areation.

While most authorities are in agreement that the chief requisite of an orchard soil is the porosity which provides adequate soil drainage and areation, the depth and chemical composition are not unimportant.[15] Rich soils are as desirable for fruit as for grain crops, although most orchards are grown on much less fertile soils than other crops. Productivity tends to grow with every effort to increase the fertility of the soil. The soils of the Ozark Region have always been less fertile than those of the rest of the state. More than a century of reckless agricultural practices has not improved them. In the first place, the soil of the region has not been enriched by glaciation. The original forest cover was dense enough to limit the growth of grasses and, therefore, precluded the accumulation of a rich humus content, so characteristic of the prairies to the north. Most of the area should never have been deforested for the rugged relief and heavy rainfall have resulted in excessive, and in some cases, ruinous erosion. The short time in which the soil is protected by frost is also a factor in influencing the amount of erosion that has taken

[13] Miller, Robert, First Report on a Forestry Survey of Illinois, Bulletin No. 1, Natural History Survey, Urbana, 1923, p. 324. Soil Maps of Alexander, Massac, and Union Counties.

[14] Coffey, George, and Ely, C. N., "Soil Survey of Johnson County, Illinois," United States Department of Agriculture, Bureau of Soils, Washington, D. C., p. 726.

[15] Gardner, V. R., Bradford, F. C., and Hooker, H. D., "The Fundamentals of Fruit Culture," p. 660.

place. The heavy rainfall has tended to leach from the soils basic elements for plant growth. The soils are particularly deficient in nitrogen. The scientific orchardist knows the importance of nitrogen in producing a healthful vigorous growth in improving the character of the fruit as well as increasing the yields. Nitrogenous fertilizer and leguminous cover

FIGURE 6.—A harvesting scene in the Ozark Region near Cobden, in the heart of the peach district. The fruit is placed in the basket and taken to the fruit shed for sorting. (Courtesy of the Illinois Central Railway Company.)

crops are used by the Ozark orchardists to reduce this deficiency and the result is most encouraging.

Excessive erosion has led to agricultural abandonment of large areas of the hill lands. The less favorably located land is reverting to scrubby second growth timber; the more favorably located and less eroded lands are gradually being absorbed by the orchardist. The development of scientifically cared-for orchards in the region will bring economic prosperity to these hill lands again. The orchards will tend to decrease the erosion and if properly cared for, will bring the soils to a high degree of fertility, and restore to the people their heritage of satisfaction with their land.

DEVELOPMENT OF A TECHNIQUE OF CULTIVATION THROUGH ACCUMULATIVE COMMUNITY EXPERIENCE

It has been noted that fruit culture developed simultaneously with the settling of the hill lands. These early plantings were not of commercial importance; they were limited to the small home orchard and the products were consumed on the farms or in the local market. But from these humble beginnings the orchards have developed into the highly specialized and intensive phase of agriculture today. The profitableness of horticulture has come about as a result of the improvements in the technique of methods of cultivation, fully as much as it has in the enlarged market, and adequate transportation development in this favored locality. Much of the technique is the outgrowth of costly experience in fruit culture. The industry has progressed as a result of a few pioneer spirits who have had a vision of the possibilities of the hill lands and have forged ahead, carrying out their ideas, demonstrating the profitableness of scientific methods. Followers are legion.

Accumulative community technique and the experimental work carried out by the Agricultural and Horticultural Colleges of the University of Illinois have clearly demonstrated to the growers the best varieties of fruit for the region, proper methods of spraying and pruning, cultivation of orchards, combating the pests and diseases, and marketing practices.

VARIETIES OF FRUIT

There are hundreds of varieties of fruit known and new varieties are being bred; but about twelve varie-

ties constitute 80 per cent of the commercial crop of the United States.[16] Each variety has its own physical limitations and each community has learned through experience which variety is best adapted to the region.

The Ozark Region is especially favored for the production of early

FIGURE 7.—This picture is a typical scene during the peach harvest. The peaches are brought from the orchard to the fruit sheds where they are sorted and packed in bushel hampers. Many of the large orchards own their own coöperage plants and make the baskets and hampers on the farm. The fruit sheds become centers for selling the fruit also. (Courtesy of the Illinois Central Railway Company.)

varieties, and it has become one of the foremost early apple producing sections in the United States. The region is admirably located with regard to markets, which is essential due to the perishable nature of the summer apple. The light colored soils, that warm up early in the spring, and the relatively low latitude make it possible for the fruit to ripen early and reach the market ahead of fruit from competing regions.[16] The chief varieties raised include the Yellow Transparent, Duchess of Oldenburg, Red June, Chenango, Sops of Wine, and Rome Beauty.[16]

The Winesap apple is the most important commercial winter variety and is increasing in production in the Ozarks. This variety does not do well on low, wet soil but yields best on light colored, well-drained soil. These requirements are met in the region. The tree is vigorous and resists diseases and insects; it is, therefore, a favorite with orchardists wherever it will grow. It is a steady producer. The fact that the fruit hangs well on the tree, keeps well, and sells well has made it a desirable variety in the region. The high percentage of sunshine available in the growing season, a condition essential for the luscious red color, is also a factor of no mean consideration tending to locate the variety in the Ozark Region.

The vigorous growth and the strong, upright form that gives the Ben Davis the ability to stand storms and wind and to support the large yields for which it is so justly famous has made this variety important in all orchard communities. But it is declining in the Ozark Region due to the ravages of the Illinois blister canker[16] and the changing taste of the public, which is requiring something better than the plebeian Ben Davis.

Among the peach varieties, the Elberta attains such a degree of excellence in the region as to make it a prize winner where it is exhibited. Although it has become the chief commercial variety, other varieties including Early Crawfords, Late Crawfords, Edes, and Heaths are grown.

SPRAYING

The lack of scientific knowledge to combat the orchard pests and fungus diseases which became unusually bad in the first part of the nineteenth century has been given as one of the reasons for the decline of the orchards in the Ozark Region. On the other

[16] Folger, J. S., and Thomson, S. M., *op. cit.*, pp. 387–398.

hand the control of these ravages by spraying has been responsible for the revival and profitableness of the orchards since that date.

Spraying is one of the outstanding differences between the commercial and farm orchard. While this adds greatly to the cost of production, it results, on the other hand, in increased yields, improved quality and size of the fruit, a surer harvest, and, therefore, a better market price.

Numerous insects and fungus diseases have made serious depredations in the Ozark fruit district. In the state of Illinois, it commonly happens that the losses from some one or more of the fungi or insects amount to a considerable part, or even to the whole, of the crop in any one season. The University of Illinois Agricultural Station reports: "During the summer and autumn of 1912 a large number of unsprayed orchards in the leading sections of the state of Illinois were visited—and in no case was there found any fruit fit for barreling, whereas, sprayed orchards in the same locality were bearing abundant crops of excellent quality. No one can doubt that attention to this one factor, spraying in apple growing, would easily increase the production of apples 100 per cent."[17]

Among the insects affecting the orchards of the Ozark Region are the San José scale, scurfy, aphids, codling moth, plum curculio, and the canker worm. Fungi, or parasitic growths, which attack the fruit, leaves, stems, and roots are exacting a heavy toll from the orchards in this section of the state. The principal diseases include apple scab, apple blotch, bitter rot, cedar rust, and Illinois blister.

[17] Pickett, B. S., "Field Experiments in Spraying Apple Orchards," University of Illinois Agricultural Station, Bulletin, 185, p. 49.

The orchards in this section are not all equally affected and infection varies from season to season. Cool damp weather encourages the growth of fungus diseases and the loss in some seasons is very great. The growth is successfully combated by the application of lime sulphur, self-boiled lime, sulphur and Bordeaux, applied "in advance of the distribution of the spores and must cover the susceptible parts of the plant throughout the period of infection."[18]

The local orchardist and the Horticulture College of the University of Illinois have united forces in combating these ravages. The effectiveness of certain sprays and the proper time of applying the fungicides have been determined by extensive and expensive field experiments carried on throughout a number of years in various sections of the state.[19] Spraying is materially affected by a number of factors; for example, the time of application, character of the weather at the time of spraying, the vigor of the tree, age of tree, slope, drainage, degree of infection, and the care with which the mixture is prepared.

CULTIVATION PRACTICES IN THE OZARK REGION

The cultivation practices are by no means uniform in the Ozark Region. These differences extend to all phases of the care of the orchards. There are many orchards planted with inferior trees and spasmodically pruned with a vigor that resembles butchery.[20] Little care is taken not to injure the trees when the soil between

[18] Directions for Spraying Fruits in Illinois, Department of Horticulture, Circular No. 266, p. 2.

[19] Pickett, B. S., *op. cit.*, pp. 51–52.

[20] Heaton, J. C. B., "The Apple Orchards of the Ozarks of Illinois," Trans. of Illinois Horticultural Society. Published by the Society, Springfield, Vol. 31, pp. 591–593.

the rows is plowed. Little attention is given to fertilization. The character of the fruit, however, reflects the care of the orchards. The number of orchards planted to selected grafted trees and carefully pruned and cultivated is increasing each year. As the small run-down orchards gradually come under the control of large producers, they are being renovated and brought to a high degree of productivity through efficient and scientific methods.

FIGURE 8.—South of Carbondale, Illinois, a splendid view of the magnificent roads being built in the region as well as all over the state of Illinois, and the rolling character of the country. Note the orchard near the crest of the hill. (Courtesy of the Illinois Central Railway Company.)

A cover crop is kept on the soil between the trees in most of these hill lands in order to reduce washing and to build up the soil. Various legumes are used.

HARVESTING, GRADING AND PACKING

The harvesting season is a very busy one, but frequently not any more so than the few weeks preceding the harvest when the farmer is engaged in getting together ladders, repairing the fruit sheds to receive the fruit, providing boxes and hampers for packing, together with numerous other details. During this period the demand for additional labor is great; especially is this true on some of the very large commercial holdings. One of the largest fruit enterprises in Union County, operated by the American Fruit Growers, Inc., is typical in its labor requirements. The president of the company reports that one man can take care of 40 acres with the exception of picking.[21] It is necessary to employ a large force of pickers at the harvest time. The labor is gathered from

[21] Editorial, *Illinois Central Magazine, op. cit.*, p. 7.

the surrounding farms and from transient labor which percolates into the area during this period. About six pickers per acre are required to gather and pack the fruit for market. So much care must be exercised in selecting the fruit when the tree is being gone over for the first time that a skilled picker can gather on the average only about 15 bushels per day, although 30 bushels is a good estimate in the final clean up.[21]

In the Ozark Region nearly every orchard is provided with sheds for sorting and packing (Figure 7). Most of the sheds are located in the orchards. The fruit is brought from the fields in baskets and then sorted by hand. Women do a great deal of this work.

The fruit is graded into three classes. The first class is the choice fruit, large in size and perfect in color. The second grade is composed of perfect fruit, smaller in size, but good in color. The culls, the third class, are composed of the green, imperfect fruit and the windfalls.[21] Practically all of the fruit of the first two classes enter the commercial market, although some fruit is sold locally to persons who come from a limited radius to the fruit sheds and carry away the fruit in their own cars. Practically all of the culls are sold from the sheds for local consumption.

The fruit harvest starts in the last part of May or the first of June with the early varieties of summer apples, and ends in October with the harvesting of the Ben Davis. Peaches are picked in August; only a few late varieties extend the season into September.

[21] Editorial, *Illinois Central Magazine, op. cit.*, p. 7.

MARKETS AND MARKETING FACILITIES

Fruit from the Ozark Region reaches markets both to the north and to the south. The large urban centers to the north, notably Chicago, St. Louis, and Springfield, take the bulk of the crop. Large quantities go into the mining centers immediately to the north of the ridge. Paducah, Kentucky, a city of 25,000, is the chief consuming center to the south.

The crop moves to market by railroad and truck. Three railway lines serve this commercial center; namely, the Illinois Central, the Chicago and Eastern Illinois, and the Big Four (Figure 1). Special fruit trains are put on in the rush season. Fruit picked one day will be in Chicago the next morning. Trucks have been used to distribute fruit within a narrow radius and with the increase of the excellent system of roads now being built in this section, the radius will be enlarged (Figures 8 and 9).

The granger system of coöperative marketing is common throughout the Ozark Region. Two shipping societies incorporated under the laws of the State of Illinois were organized at Cobden, Union County, about 25 or 30 years ago.[22] This date corresponds with the beginning of the revival of the fruit industry. Cobden lies on the north side of the ridge near the crest in the heart of the peach district; it is also located on the Illinois Central Railroad which gives it the most direct route possible to Chicago, the largest market for the area. Each town has its own local shipping society; at present there is

[22] Round table discussion, "Means of Marketing," Trans. of Horticultural Society of Illinois Vol. 47, New Series, pp. 461–464.

no attempt made toward the amalgamation of the smaller societies. Each association is controlled by a board of directors and employs a manager and necessary assistants.[22] The principal duties of the manager are to receive the fruit, superintend the packing of the cars, and forward the fruit as it accumulates. Approximately 90 per cent of the crop moves to market through the agency of the shipping society. The individual growers may send the fruit to any commission house but the fruit is consigned to one man in Chicago who receives it and sees to its distribution to the particular commission merchant addressed.[22] The societies are financed by membership fee and a legitimate charge per package when the fruit is shipped. All expenses are paid through this method of exchange.[23] The benefits which accrue to the individual are too well known and need not be commented on here.

FIGURE 9.—Trucks are used to market the fruit within a short radius. This means of transportation will no doubt be used extensively in the future.

SUMMARY

The Ozark Region is a geographic and an economic unit of the state of Illinois. Agriculture has been the dominant industry from the time the first settlers cleared the forest-clad slopes until now. However, the industry has taken different forms in its development. Grain farming with corn as the main crop dominated the pioneer stage. At the present time the trend in the utilization of the land is toward intensive fruit culture. General farming is of secondary interest in the hill lands, but remains important in the alluvial lands of the Mississippi flood plain and larger valley bottoms. The industrial development is a response to geographic and economic conditions. The interplay and evolution of the elements of the environment come out in the history of the agricultural activities of the area. While the elements have shown varying degrees of strength in the different periods, they have operated, nevertheless, persistently.

The future development will probably follow the present trend. The land physically available for expansion is great. The limiting factor will be a lack of demand for the fruit which the region is capable of producing.

[22] Round table discussion, "Means of Marketing," Trans. of Horticultural Society of Illinois, Vol. 47, New Series, pp. 461–464.

[23] Lloyd, J. W., "Coöperative Marketing of Horticultural Products," University of Illinois Experiment Station, Circular 244, pp. 3–15.

AGRICULTURAL REGIONS OF SOUTH AMERICA

INSTALMENT III

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MEDITERRANEAN CROPS REGION

EXTENDING from about 38° S., a little south of Concepción, to 30° S., the latitude of Coquimbo, the Mediterranean Crops Region embraces a belt 50 to 125 miles wide and about 650 miles long. It includes the coastal valleys, coastal ranges, and the northern two-thirds of the central valley. It presents striking contrasts in climate, relief, vegetation, soil, and agriculture to the rainy forested region of the south or to the parched desert stretches of the north.

Characterized by winter rains and summer droughts, the region receives in the lowlands from 30 inches of precipitation per year on the southern margin to less than 10 on the northern. In general, the heaviest precipitation comes on the intermediate slopes of the Andes in the direct path of the western winds (El Tenienta, 6,828 feet, has an average annual precipitation of 45.63); the coastal ranges get about half as much as Andean stations in the same latitude while the central valley receives less than one-third as much as the Andean region. Coming in the winter half of the year, April to September, the precipitation in the form of snow in the Andes is conserved for the growing crops in the valley during the summer. The long growing season, six months in the south and twelve in the north, mild winters, hot dry summers with bright sunny skies, and winter precipitation favor irrigation agriculture as do also the relief and soils.

From the standpoint of relief the region falls naturally into two strips: (1) the coastal strip comprising many small fertile coastal valleys separated by the rather rough coastal ranges, which rise abruptly from the sea to an elevation of one thousand feet here and there, but broken in several places by large valleys that reach the sea, and (2) the level to rolling fertile waste-filled central valley sloping gently from the Andes in a broad piedmont alluvial plain and dipping slightly toward the south, but crossed by many large rivers from the Andes.

Varied native vegetation prevails. In the southernmost part of the region *roble*, *pellin*, *coihué*, and *ciprés* cover as much as 6 per cent of the total area; the coastal beech forest occurs in broken patches to 35° S. and the Andean forests extend to 34° S. and farther in scattered areas. Much of the original forest in the valley has been cleared to provide farm lands and wood. In the north, hard and small leaf-shrubs, like *quillaja*, *saponaria*, *sumac*, and *escalloma*, resembling Mediterranean evergreen oaks, grow in the coastal ranges and cover the slopes of the Andes. The central valley floor is covered with various grasses and thorny shrubs, mostly evergreens, which resemble chaparral and maquis.

In general, the soil, extremely varied, is rich in plant food materials. River alluvium usually consists of

dark rich clay loam; adjacent hilly land has clay; in the piedmont gravel is common, while sandy loam covers large areas. The milky white irrigation waters add new soil materials to the fields with each application of water.

The Mediterranean Crops Region, although occupying a small part of the country, is by far the most important agricultural region of Chile; it has nearly two-thirds of the cultivated land, 95 per cent of the vineyard acreage, the barley acreage, the corn acreage, and 85 per cent of the alfalfa area. It produces 98 per cent of the Chilean wine, 66 per cent of the wheat, and grazes a big share of the livestock even with semi-arid conditions. Only about 12 per cent of the area is in crops, but nearly three-fourths of the area is in pasture, much of which consists of brush hill land pasture of low carrying capacity.

Although, in a general way, conditions are similar throughout the region, differences in relief, soil, rainfall, and intensity of land use justify the recognition of two sub-regions: the Central Valley Sub-region and the Coastal Valley-Coastal Mountain Sub-region.

THE CENTRAL VALLEY SUB-REGION

Lying between the coast ranges and the Andes, the Central Valley Sub-region stretches southward from 32° S. latitude for four hundred miles, and includes the northern two-thirds of the central valley. This area with the south humid portion constitutes the main part of the country; it is the most densely settled and richest agricultural region on the entire west coast of South America.

The level to rolling surface of the central valley is broken in places by low transverse hills and by major streams that cross the valley from the Andes and enter the sea through breaks in the coast ranges. Broad piedmont alluvial plains slope gently away from the base of the Andes. Rich in mineral matter the sandy, loam, and clay loam soils stimulated by bright sunshine and irrigation water have made this region the "promised land of Chile."

Climatic conditions favor crop production. Among them are a long growing season, mild winters (the average temperature for the three winter months at Santiago, near the northern end of the valley, is about 47° F.), hot dry summers (the summer temperature at Santiago averages nearly 68° F.), and the large amount of sunshine ideal for the ripening of fruits and cereals, so important in this region. The central valley lies in the rain shadow of the coastal mountains as arid Argentina lies in the greater rain shadow of the high Andes. Receiving only an annual rainfall of ten to thirty inches, most of which comes in the winter, the region must depend upon the greater precipitation of the Andean slopes for its water supply.

IRRIGATION

Nearly all the crops grown during the summer months must be irrigated; in fact, the sub-region is one largely of agriculture by irrigation; it contains about 90 per cent of all irrigated land in Chile (Fig. 37).[1] Conditions are almost ideal for irrigation: sloping alluvial plains, on which it is easy to direct water from the sediment laden streams rising in the high mountains where heavy winter snows melt slowly during the

[1] ECONOMIC GEOGRAPHY, Vol. 4, No. 2: "Agricultural Regions of South America," by the author.

TABLE II

AGRICULTURAL STATISTICS IN SELECTED DEPARTMENTS *

I. Items	Central Valley			Coastal Sub-Region		
	Maipo †	Loncomilla	Bulnes	Casablanca	Chanco	Concepción ‡
	(Areas by Acres)					
Area	323,206	216,459	175,935	389,182	236,474	211,517
Area in land holdings	311,428	198,908	160,944	370,083	130,083	90,806
Area in crop:						
Fruit	4,035	8,638	2,866	748	59	3,511
Other crops	34,564	23,575	35,458	36,328	22,043	7,059
Pastures	137,444	144,736	107,046	230,943	52,797	59,459
Wood and forest	105,586	10,845	8,492	93,079	35,583	14,005
Waste land in farms	29,790	11,197	6,587	9,503	19,599	4,811
II. *Irrigated Land and Land in Crops, Acres—Four-Year Average, 1919–20 to 1922–23*						
Irrigated land	96,107	46,960	57,001	6,685	486	1,925
Vineyards	2,360	7,810	2,331	603	26	2,568
Wheat	13,730	10,590	16,875	7,745	10,125	3,715
Corn	2,390	1,480	1,178	124	246	69
Alfalfa	11,220	49	158			
Barley	6,000	72	10	11,400	89	62
Beans	1,985	1,622	2,652	284	432	356
Potatoes	989	230	760	332	1,198	235
Clover	179	1,060	1,690			40
Oats	74	54	47	12	6	64
Vetch	37	14	130	143	772	67
III. *Number of Animals—Four-Year Average, 1919–20 to 1922–23*						
Cattle	30,198	17,513	16,249	18,701	5,644	5,074
Sheep	12,461	33,918	15,542	34,584	3,883	1,428
Goats	1,131	2,282	865	1,116	380	201
Horses	5,321	4,360	3,314	3,957	1,695	1,112
Mules	243	287	99	1,272	109	37
Swine	2,260	3,619	3,902	943	1,269	600
Dairy cows	3,431	1,886	1,471	1,123	154	523
IV.						
Population	33,486	28,098	22,504	12,101	17,932	82,662

* Statistics compiled from *Anuario Estadístico de la República de Chile, Agricultura, Año* 1919–1920 to 1922–1923.

† Maipo and Casablanca lie in the same latitude; Loncomilla and Chanco, and Bulnes and Concepción. A contrast of these departments by pairs shows interesting results.

‡ The population of the city of Concepción is 64,074; without the city population, Concepción is similar to the other two coastal departments.

long, dry summer, ample supply of water, long hot summers with an abundance of sunshine, deep alluvial deposits which hold waters like huge sponges, but which are fairly well drained, and deep fertile soils. The fields along the river terraces and the great estates on the broad piedmont alluvial plains would be unproductive were it not for the life giving waters of the Aconcagua, Maipo, Maule, Itata, Laja, Bio Bio, and numerous smaller streams. In addition to turning the river waters upon their lands, many farmers have constructed reservoirs to preserve winter rains for use during the growing season.

Until recently all irrigation systems were maintained on individual *hacendados*, by associations of land owners. Now the government is increasing the crop land; near Santiago extensive irrigation works that water some 62,000 acres have been installed; a canal tapping the Maule River has been extended and irrigates 115,000 acres; farther south from the Laja River newly constructed canals irrigate 110,000 acres.

THE USE OF THE LAND

The central valley, having the large areas of alluvial plains easy to irrigate and the most available water supply, represents the more intensive use of the land of the two sections of the Mediterranean Region (Table I). Considering the three departments—Maipo, Loncomilla, and Bulnes—which are representative areas in the central valley, approximately 93 per cent of the total area in these depart-

ments is in land holdings of which 29.8 per cent is irrigated, against 73 per cent of the area in the Coastal Sub-region departments in land holdings and 1.5 irrigated. In the former, 16 per cent of the area in land holdings is in crops, 55 per cent in pasture, and 20 per cent in woods and forests, while in the latter departments 11 per cent of the area of land holdings is in crops, 58 per cent in pasture, and 25 per cent in woods and forests. In addition the population density of the departments in the central valley amounts to 75 per square mile and that in the Coastal Sub-region departments only 37 per square mile (excepting the city of Concepción, all the areas represent rural districts). Furthermore, the departments in the central valley have more than twice as many animals as those in the Coastal Sub-region. The contrasts revealed in these representative departments hold true, as a whole, for the sub-regions they represent.

FIGURE 42.—Threshing wheat with horses in the central valley. Men often go from farm to farm threshing grain on a percentage basis. The threshing floors are made by removing the sod and hardening the surface by fire.

CROPS

In the Central Valley Sub-region nearly three-fourths of the land in crops grows wheat, corn, barley, oats, alfalfa, clover, vetch, beans, and potatoes, and about 12 per cent is in vineyards.

Wheat, the principal crop throughout the valley, is the main bread cereal and the only crop which consistently furnishes a surplus for export. Oregon and *Ruhille* of Naples are the best varieties for quality, weight, yield, and rapid growth. Generally, wheat is sown broadcast in autumn (May and June) on land plowed in the spring, allowed to lay fallow during the summer, and plowed or worked with heavy harrows again at the time of the first fall rains. Harvested with small reapers or with hand sickles, the grain is threshed on large farms by machines, but in many sections by horses being driven over it on fenced dirt threshing floors (Fig. 42). Owing to almost ideal conditions of climate—(1) cool, moist, formative period in the autumn and early winter, (2) moist, warm period in spring, and (3) then a dry, hot, sunny ripening and harvesting season, to fertile soil, and to freedom from diseases and pests—yields are quite high, 25 to 30 bushels in the

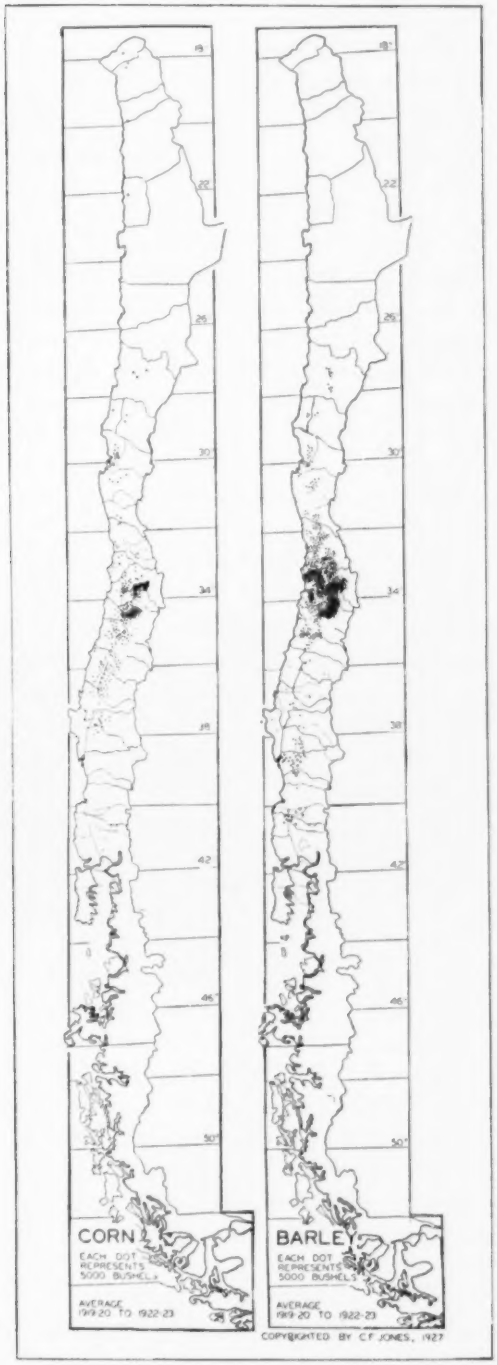

FIGURE 43.—The chief area for the production of both barley and corn consists of a restricted section in the central part of Mediterranean Chile.

valley, in spite of poor methods of tillage and harvesting. So valuable is it to the farmer in this semi-arid region that it occupies about 50 per cent of the land in crops.

Although barley is grown in all parts of Central Chile, the bulk of the crop comes from a small area in the northern end of the central valley, and the adjacent coastal strip (Fig. 43). Almost entirely a cash crop, it is grown near the large cities and the chief ports; most of the barley is used for the manufacture of beer or is exported. Suited to the climatic soil, and other conditions, throughout the central valley high average yields result. As with wheat, a great deal of the barley grows without irrigation.

Indian corn, although indigenous to Chile, and early consumed as a style food, is not grown extensively now except as a forage crop. Almost the entire production of the country comes from the Central Valley Subregion (Fig. 43). Planted from September 15 to the end of October on recently plowed land, the lack of moisture and the cool nights, in spite of hot days, retards the growth of corn so that much of it does not mature properly. Individual farmers never plant more than a few acres, which may be husked or grazed by work animals or other stock. A little may be ground into meal, some converted into *chicha*, but the greater portion is used as feed.

Beans, peas, chick peas, and lentils are staple foods for the masses; they find their greatest area of production in the central valley; they often occupy the same place in the rotation of crops as corn. Potatoes, consumed in large amounts, occupy small areas owing to high yields per acre. A variety of truck and garden crops of semi-tropical and temperate varieties receive much attention over

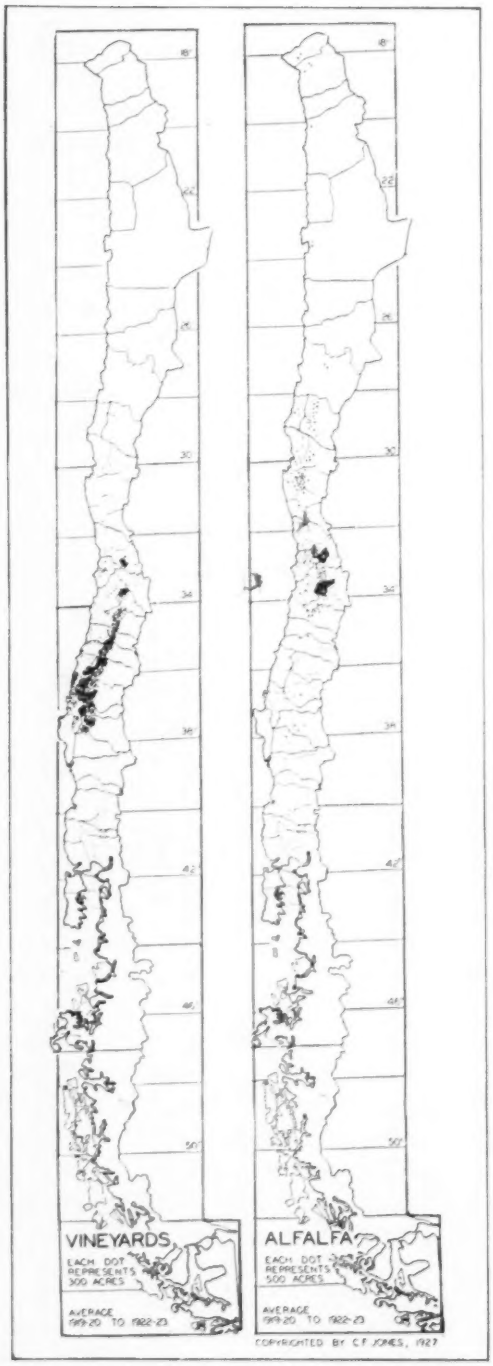

FIGURE 44.—Nearly all the vineyards of Chile are in the Mediterranean Region, mostly the Central Valley Sub-region; alfalfa grows almost entirely in the more arid sections.

the entire region. The mild climate permits hardy vegetables to grow throughout the winter in some sections; frequently, four crops of vegetables a year are obtained from irrigated land.

Fruits

A long growing season, free from extremes of heat or cold; abundant sunshine; deep, fertile, well-drained, sloping, alluvial lands; and irrigation water applied when needed—all favor the production of a variety of subtropical and temperate fruits of excellent quality.

Grapes are by far the most important fruit grown, vineyards occupying, next to wheat, more land than any other crop, more than 12 per cent of the land in crops in the central valley. Most of the vineyards are located about 2,000 feet above sea-level and in this sub-region depend on irrigation. Many large and small land owners have most of their entire land holding in grapes, growing only such minor crops as are necessary for food and feed for the estate. While considerable quantities of grapes are consumed in the fresh form during the season, the bulk of the crop is used for wines of varying grades, some being aged for years before going onto the market. From French, Spanish, and Italian stocks, the yearly production in Chile amounts to some forty million gallons, most of which comes from the central valley (Fig. 44). As in Mendoza, Argentina, modern methods prevail, in general, in Chile.

Several fruits—lemons, oranges, quinces, figs, peaches, apples, pears, cherries, plums, avocados, and small fruits—are produced in farm orchards for family needs of most every estate. Lemons, grown especially in the district south of Santiago, ripen mainly in the winter season, although they

are harvested in different sections throughout the year from isolated trees or small garden orchards. Oranges of medium size and having few seeds come onto the market from April to November. Quinces, consumed for the most part in the canneries for the making of delicious marmalades, very popular in Chile, thrive without care along water courses and irrigation ditches in the central valley. In addition to the large consumption of fresh fruits during season, quantities are canned and from nearly one million to four and one-half million pounds of dried cherries, prunes, quinces, raisins, pears, figs, and peaches are produced each year. For the sun-dried fruit industry, the hot sunny and rainless autumn is ideal.

LIVESTOCK

The livestock industry forms an essential part in agricultural practices on nearly every farm in the Mediterranean Region; most farmers keep nearly all classes of livestock to meet the many needs of each estate. But in the semi-arid portion of Central Chile, stock-raising becomes secondary to crop production, owing to the restricted areas of even fair grazing lands.

Alfalfa, red clover, and vetch, grown under irrigation especially in the central valley, furnish the chief hay crops and supply the best forage. Alfalfa may be cut for hay three times during the year and grazed in the meantime; it is especially prized as fattening forage for cattle for the city markets and for the nitrate fields and mining camps. Native, unirrigated range on the whole does support large numbers of animals. *Atriplex Semibaccata*, similar to "grease wood," which resists drought and re-

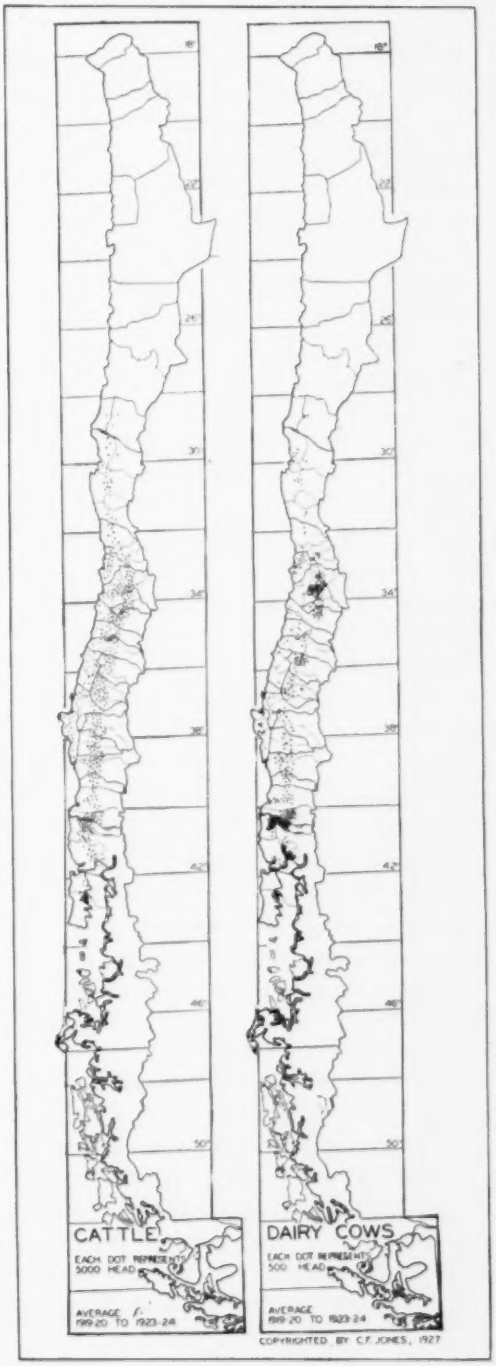

FIGURE 45.—Cattle kept chiefly in the Mediterranean Region and the Humid Pasture-Crop-Forest Region are used for draft purposes, for meat, and incidentally for milk. The major dairy sections lie near the cities.

mains green all summer, supplies the best forage between Río Coquimbo and the Maule. Sudan grass and wile grasses, which are also drought resistant, provide a small amount of pasture.

Approximately 40 per cent of the total number of cattle in Chile are in the Mediterranean Region, chiefly the Central Valley Sub-region; they are used for a local supply of beef, dairy products, and draft animals (Fig. 45). Consequently every *hacienda* has its quota. Irrigated alfalfa and clover fields, native valley and mountain pastures, and mild, open winters promote year-round grazing. Herds of cattle, horses, and sheep move to mountain pastures in early spring, tended by a herdsman, and remain in the mountains until winter rains give life to the hillside pastures and the untilled flats in the central valley. Sixty per cent of the Chilean horses and 25 per cent of the mules are raised in this region. Horses, principally used for riding purposes and racing, a national pastime, find little use for draft purposes except in large cities; on the farms oxen or mules are preferred for draft uses.

Sheep, found in small numbers on nearly every farm, follow the cattle from pasture to pasture or graze on the brush lands during the rainy season; in summer they move to irrigated fields in the valley or to mountain pastures in the Andes. In general, of medium-quality mixed breeds, they supply an essential item of food and clothing material. A significant part of the rural population makes its woolen clothing from the fleece of small farm flocks. The semi-arid central valley and the adjacent coastal ranges graze nearly half the sheep of the country (Fig. 46).

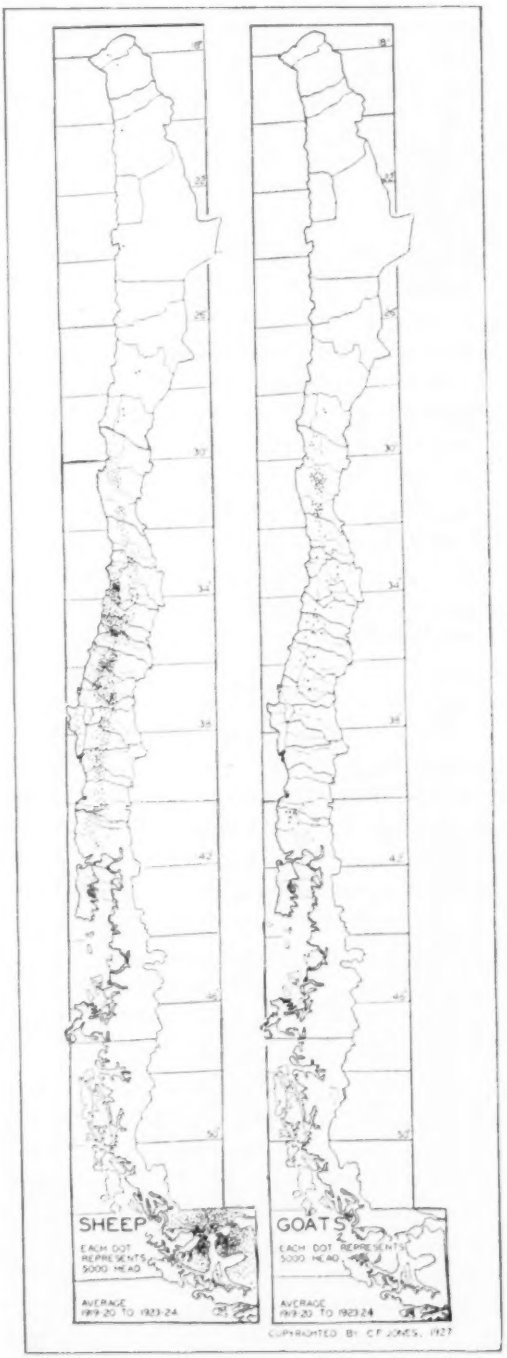

FIGURE 46.—Chile has two sheep regions—the rainy, cold region bordering the Straits of Magellan, and semi-arid Mediterranean Chile, but goats are largely confined to arid roughlands between 28° and 34° S. latitude.

THE COASTAL VALLEY–COASTAL MOUNTAIN SUB–REGION

The Coastal strip of Mediterranean Chile includes many small coastal valleys and both slopes of the coastal ranges from 30° S. to 38° S. For much of this distance the coastal range rises abruptly from the sea; only the ribbon-like valley floors have level land to which irrigation water can be applied. Although this sub-region receives more rain than the central valley, the winter rains are not sufficient for crops, making irrigation necessary. Thus climate and relief restrict the arable area to very small isolated strips. Several large streams from the Andean snow fields flow through breaks in the coastal range, but the waters enter the Pacific for they cannot be utilized on the upper river terraces and the lower slopes that need only water to yield good crops.

As a result of a paucity of level land, only about two-thirds of the area is in land holdings, less than 2 per cent of which is irrigated. In addition, much waste land in farms and large areas of brush range land of poor pasture add little to the sub-region.

From the standpoint of agricultural production, the crops grown and the animals grazed are similar to those of the Central Valley Sub-region. Wheat, barley, grapes, beans, potatoes, and alfalfa are the principal crops. Barley, more drought resistant than other crops, finds relatively a more important place on the semi-arid hill lands; much of it and the wheat grows without irrigation, as the rainfall of 10 to 30 inches from north to south, coming in the six winter months, gives these cereals a cool, moist, formative period in autumn; a warm, wet, growing period in spring; and a dry, hot, sunny ripening and harvest season. Near the southern end, nearly half of the vineyards do not require irrigation.

Sheep, goats, and mules are more important in the systems of farming than in the Central Valley Sub-region, owing to their adaptation to the semi-arid shrub, rough hill pastures, where cattle and horses would indeed find precarious pickings. Most of the goats of the entire country graze in the northern portion of this sub-region.

Being isolated in the many small coastal valleys and lacking transportation facilities each large estate produces nearly all the products of the farm and the range required by the population.

SIZE OF LAND HOLDINGS AND LAND TENURE

Throughout the Mediterranean Region enormous land holdings prevail as they do in all parts of Chile, except in areas occupied by the Germans and the Dutch in the south, in small irrigated valleys here and there, and near Santiago where the growth of the city has caused a marked rise in the price of the land. In this region farms of twenty hectares or less amount to 72 per cent of the total number of farms, but they embrace only 2 per cent of the area in land holdings; 1,107 farms of 1,001 to 5,000 hectares include 22 per cent of the land in farms and 405 estates of more than 5,000 hectares comprise 53 per cent of the area. Thus, 1,512 owners control three-fourths of the land in farms.

These vast *haciendas*, some of which include entire coastal valleys and adjacent hill lands, a whole *comuna*, or stretch from the foothills

of the coastal ranges across the central valley and high up into the Andes are permanent; no tendency towards breaking them up exists, and few change hands except as they pass from father to son.

Inquelinos, farm laborers, almost as permanent as the land holdings, spending a lifetime on one estate, seem to be almost a part of the property. They must be housed, fed, and clothed by work on the estate; furnishing a good supply of rather cheap labor, at all times, they decide in most cases how the farm work shall be done, and restrict the use of modern implements and methods. Cheap labor and abundant harvests from the large estates retard the expansion of agriculture. With only one-third of the available farm land of all Chile profitably used for agriculture, a marked agricultural development lies ahead for the Mediterranean Crops Region.

CHILEAN COASTAL DESERT

From the Mediterranean Crops Region to the northern border of the country stretches the Chilean Coastal Desert, a strip 50 to 100 miles wide and about 800 miles long. Essentially a barren, almost rainless area it affords little in the way of agricultural enterprises. Only scattered and isolated, but cool and refreshing, oases break the monotony of the drab nude reaches. In northern Chile only .02 per cent of the land supported crops in 1925 and only 2.3 per cent pasture.

On the west a narrow coastal range rises abruptly from the sea to heights of 1,000 to 3,000 feet. Beyond, a level to gently rolling surface of sands, gravels, bare rock ridges, pebble pavements, and *salars* stretch to the foothills of the Andes, which rise in a broad and somewhat regular slope. Near the northern and southern ends a mountainous knot of broken country rises above the waste-filled basins of the central part. In this broken country thread-like valleys which receive water from the higher Andes to the east afford small level tracts for irrigation agriculture. Of the numerous streams that gather moisture from the snow fields, glaciers, and rains of the high Andes and rush down the western flank of the Andes, less than half a dozen reach the sea, because their waters disappear in the deep porous piedmont alluvial plains, or in the thirsty atmosphere.

The lack of precipitation restricts farming and even grazing for the region as a whole to the areas where water is available for irrigation. In almost a rainless region—only the southern part receives as much as six inches of precipitation per year; vast areas have been without one drop of rain for half a century and possibly longer—farming and grazing are restricted to the areas where water is available for irrigation, except in the southern portion where the small but certain rains afford scant forage for goats and asses, and on the seaward slope of the coast ranges where the thick fog bank may give rise to a drizzle providing moisture for lowly desert shrubs and grasses for a brief period. Mean monthly temperatures for most of the region are above 50° F., showing a rather small annual range; yet the intense insolation and rapid radiation cause a marked change between day and night. Although increasing the handicaps of drought, the high temperatures favor the production of most of the subtropical and temperate products.

While the coastal desert embraces nearly 20 per cent of the total area of Chile, it holds only 5 per cent of the irrigated area and only 7.9 per cent of the pasture land. Range land in this region, other than that in irrigated valleys, has a low carrying capacity. Pasture lands of this type comprise nine-tenths of the total area devoted to pasture. Much of it consists of brush hill land with very sparse grasses on which voracious goats graze (Fig. 47). The southern portion has four-fifths of the irrigated land and three-fourths of the pasture of the region.

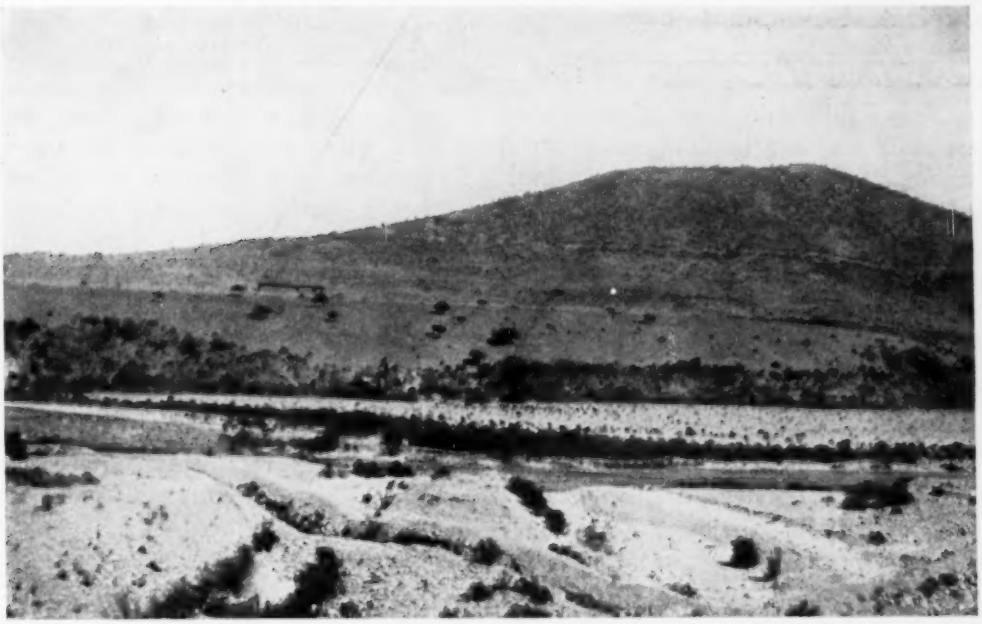

FIGURE 47.—Brush hill land pasture near Vallenar in the southern part of the Chilean Coastal Desert. In the middle foreground is the dry arroyo. This picture, taken at the end of the dry season, shows no grass. During the short rainy season goats and sheep graze on a sparse growth of grasses.

Agriculturally, the region is one of small isolated irrigated valleys and piedmont oases, largely self-dependent and producing a variety of products for domestic consumption and some surplus for nearby mining camps and ports. Alfalfa, adapted to arid conditions and deep alluvial soils, leads other crops in area; it serves as valuable forage and as dry feed for the cattle, horses, mules, and asses which constitute essential equipment in the oases and in the mining districts.

Corn, which may give two crops per year, serves as pasture and feed and also as food for a considerable share of the people; it occupies about one-fourth as much land as alfalfa; it may be planted any month, but usually it is planted in June and December. Grapes for wine are cultivated in nearly all the valleys, but especially in the southern portion. As in most areas of subsistance agriculture, the oases grow a variety of vegetables and fruits, for which the soils, temperatures, and sunshine are favorable.

Separated by vast spaces of gravels, sands, bare rock and *salars*, these oases afford little chance for marked

expansion; they possess only a restricted supply of water at best; the amount of land to which water can be applied varies greatly from year to year. During serious droughts, lands generally farmed or pastured are entirely abandoned. Attempts to increase cultivation have met with little success. Restricted irrigable land, small water supply, and poor transportation facilities denote permanent small stagnant and self-dependent communities.

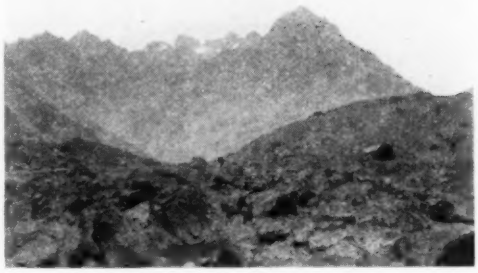

FIGURE 48.—The high, rugged Andes, latitude 32½° south. Much of the southern section of the Arid Andean grazing region consists of high, barren, snow-covered mountains, similar to the area shown in the picture.

ARID ANDEAN GRAZING REGION

The Arid Andean Grazing Region extends for nearly 300 miles, from about 8,000 feet on the western flank of the Andes in Chile to the eastern slopes of the Cordillera and the eastern spurs in northwestern Argentina. It embraces (1) the high western range of the Cordillera from northern Chile to about 37 degrees latitude, (2) the *Puna de Atacama*,[2] and (3) the eastern range of the Cordillera. Cold, arid, and elevated, the region constitutes the greatest barrier and most desolate area in the Andes (Fig. 48). Farther north the high valleys are moister and warmer; farther south the mountain zone narrows and decreases in elevation.

The western range averages nearly 13,000 feet, with summits rising to 20,000 feet above sea level. In the *Puna de Atacama* the average elevation of the basin floors is more than 12,000 feet above sea level; peaks and ridges rise 1,000 to 5,000 feet above them. Near 28° S. the Puna ends, where the two great ranges of the Andes merge and extend southward in a single towering snow-covered range, which attains an elevation of 22,000 feet in Aconcagua, the highest point in South America. Although most of the region lies above 9,000 feet elevation, it is not extremely rugged. Much of the area consists of broad plateau fragments and lava fields, making the platform on which the high snow-covered peaks stand.

The entire region receives less than 10 inches of precipitation per year (Fig. 2).[3] In the north 90 per cent of the precipitation comes from October to March, but in the southern part it consists mainly of winter snows. It has relatively low temperatures owing to high elevation, and is windswept. Only in the sheltered basins and valleys are crops free from freezing temperatures, even in the middle of the summer. In summer winds blow chiefly from the east, but in winter from the west. Usually calm mornings are followed by winds rising to gale strength in the late forenoon, lifting blinding columns of dust and continuing until shortly before sunset. Although the entire region is arid, differences of precipita-

[2] *Puna de Atacama* is the name given to the mountain knots, chains, alluvial piedmont plains, valleys, and salt-covered basins that lie between the western and eastern Cordillera in southern Bolivia and northwestern Argentina.

[3] ECONOMIC GEOGRAPHY, Vol. 4, No. 1: "Agricultural Regions of South America," by the author.

tion influence greatly vegetation and activities.

On the western flank of the Andes from 8,000 to 11,000 feet, a small but certain zone of precipitation, usually in the form of snow, gives rise to a temperate zone grass belt that extends the length of the region; above 11,500 feet the grasses give way to bunch grass, ground mosses and resinous shrubs of the alpine zone. On the eastern mountain wall and its peaks regular precipitation results in a thin cover of herbaceous plants above 7,000 feet and of scattered clumps of *ichu* grass at higher elevations. The enclosed basins of the *Puna de Atacama*, between these mountain walls, is exceedingly dry; precipitation is so slight that drainage is absent over extensive areas; *salars*, or salt plains, cover vast districts. Fresh water is lacking in much of the regions; resinous shrubs and tufts of bunch grass comprise most of the vegetation. In the southern narrow high mountain part of the region, heavy winter snows block mountain passes and drive flocks and shepherds to milder valleys below.

Isolated, arid, cold, and without a great deal of fresh water, the region supports a sparse population of Indian shepherds and farmers. The inhabitants seek the rainy belts on the eastern margin of this region and on the western flank of the Andes. Most towns of any size lie below 10,000 feet in sheltered valleys or at cross roads; many isolated settlements, usually of from one to ten huts and a group of corrals, dot the bleak surface of the *Puna de Atacama* at elevations from 10,500 to 13,000 feet, but few permanent settlements exist at higher elevations in this part of the Andes.

Handicapped by low precipitation, a small amount of water for irrigation and low summer temperatures, the production of crops assumes little importance. On the *Puna de Atacama* and the lower slopes of the mountains near a spring of fresh water or a thread-like stream, alfalfa and barley are cultivated for forage, and potatoes, quinoa, and beans for food. In the lower valleys, protected from the winds, corn, alfalfa, barley, and wheat are grown on the scattered plots of precious watered land. With poor methods of tillage and with a meager water supply, the Indian reaps a small harvest. Quinoa, barley, and wheat are cut by hand or pulled up by the roots, threshed on clay floors by animals and winnowed by hand; any surplus alfalfa is cut to provide winter forage, a commodity in great demand. In spite of many self-sufficient communities, the region as a whole, like the Chilean Coastal Desert, is deficient in crop products. The cultivated fields, fenced off during the summer, are opened to the flocks as they return from the mountain pastures. Many of the larger or more fertile oases serve as stopover stations for mules and cattle from the *vegas* and valleys of northwestern Argentina on the way to the mining camps of Bolivia or the Chilean Desert.

Grazing of sheep, llamas, alpacas, and asses constitutes the chief occupation of most of the people. Horses cannot live upon the high mountain areas, and cattle are few in number. To the chief animals the Indians turn for their articles of clothing, rugs or sleeping mats, footwear, some food, and much fuel. Also, the llama and the ass afford a cheap means of transportation as pack animals, because they subsist on little food gathered along the trail.

For the region as a whole, the sparse growth of grasses and herbaceous plants affords meager forage, except in irrigated pastures. Variations in precipitation and temperature from season to season and from year to year cause extensive migrations of flocks and shepherds in quest of pasture; vast areas of salt plains in the Puna afford neither fresh water nor forage. In the spring of the year flocks move from the irrigated alfalfa and other fields in the valleys up the ravines and mountain slopes under the care of men, women, or even children, to graze on grasses, mosses, or resinous shrubs. In some places where water is available, some member of the family moves with the flocks to the mountain zone for a season. Customarily boys, girls, and old women remain in the valleys to care for the fields and restricted crops and to guard the fixed property of the family. In other areas lacking water, the shepherds move into the high pastures for three or four days, returning to the rivers, springs, or wells at lower elevations for water and thence again into the mountains for a like period. Some families have two huts, one in the valley and the other in the high range country. The approaching winter cold at high elevations turns the shepherd and his flock towards the warmer irrigated valley lands. In contrast to the shepherds of the Andes farther north, who spend the whole year at high elevations because they can endure a few weeks of cold weather, the shepherds of the Andean Grazing Region move out for the season, as it would be impossible for them to remain during winter at the summer camp in the high belt. When they come down, they must move to the oases, for no other place will support them; also they must come with rights to valley land and water, else the migratory system would not be possible. Even in these settlements, scant forage forces the animals to graze on shrubs and dry desert grasses.

On the whole, this region will continue dominantly a grazing region with a sparse population of semi-sedentary and semi-nomadic Indians. Though some development of the range at intermediate elevations below the *salars* or above the irrigated strips is possible, it is a task beyond the meager means of the present population. Increasing the range and the irrigated fields, providing wells, and storing water require amounts of capital far in excess of that at the command of the Indians. Not only that, but improvement of transportation facilities in the region makes possible the importation of foodstuffs and supplies that replace, in the mineral districts near the region, the produce of the local fields and ranges. Also, any decrease in activity in the nitrate fields, borax workings or other mineral areas, will cause a decline in the pastoral villages of the Arid Andean Grazing Region.

CHACO QUEBRACHO GRAZING REGION

The Chaco Quebracho Grazing Region extends from the average westward limit of intensive cattle grazing near the Paraguay River on the east to the oases and *vegas* of northwestern Argentina on the west; from the southern border of extensive quebracho stands in northern Santa Fé to the northern border of quebracho in northern Paraguay and in southern Bolivia. A vast area of tall tropical grassland stretches interspersed with straggling strips or

scattered clumps of quebracho forest along water courses and with sentinel-like, solitary palms (*copernicia cerifera*), it is a region of sparse population, primarily of backward Indian tribes. Only in the central and southern portions have cattle *estancias* and cotton made their imprint upon the area. Only along navigable water courses have quebracho plants penetrated this little-known, subtropical lowland country.

PHYSICAL CONDITIONS

With only a slight elevation above the sea, a scant slope from the northwest, and a high degree of flatness, the Chaco is subject to rather frequent and extensive inundation. A heavy precipitation in the back country may flood a wide area to the depth of several inches. The slope of the surface is not sufficient to provide a rapid runoff; a saturated soil does not absorb the surface water. Only by the sluggish meandering and often ill-defined streams is the water carried off, except that which escapes by evaporation. Serious floods occur by the rising of the Paraguay which backs the water into the Chaco several miles from the main stream. Here and there slight rises of the ground provide safe havens for stock at times of heavy inundations.

Essentially subtropical, the region has a considerable range of temperature; during the summer months, the temperature may arise to 106° F. and in winter it may drop to 33° F., or in places even below freezing. In general three and one-half months are uncomfortably hot, one and one-half disagreeably cool, and the remainder pleasant. Sudden changes of temperature result from the rapid and rather frequent changes in winds from the enervating hot north wind to the cool south wind, which may bring a deluge of rain. The annual rainfall increases from about 25 inches in the west to 50 inches in the east. Most of the precipitation comes during October to April (Figs. 3, 4, and 5);[4] the winter months—June, July, and August—have a total of less than two inches. Then streams become mere ribbons, waterholes dry up or become saline, and the grasses die down. Serious droughts occur from time to time.

As a result of subtropical temperatures, precipitation distribution, and drainage, the Chaco consists of extensive park-like savannas, a region of tall, coarse, subtropical grasses, straggling strips of quebracho forest along the streams and patches of tall palms (Fig. 49). True forest belts, palm groves, patches and strips of tall grasses, swampy tracts, and true open grass lands succeed one another at varying intervals. Towards the western margin the algarroba (*prosopis*) is of value to the natives; two varieties yield shelled fruit, used for making flour, or a beverage, algarroba also supplies building material.

THE QUEBRACHO INDUSTRY

Although not important throughout the entire region, the quebracho industry from a commercial point of view leads the cattle industry and the production of crops. The exploitation of quebracho is confined for the most part to a narrow belt along the west side of the Paraná and Paraguay Rivers, sections not far from cheap water transportation. Towards the west the number, size, and value of trees decrease as do also the number of forest belts. There

[4] ECONOMIC GEOGRAPHY, Vol. 4, No. 1: "Agricultural Regions of South America," by the author.

are three branches of the quebracho business: (1) the exportation of logs for the manufacture of extract abroad, the original phase of the industry, (2) the manufacture of the extract in the quebracho region, a later development, and the exportation of the finished product, and (3) the production of structural timbers, as a whole, a minor part.

Quebracho has come to be the most important source of tannin extract in the world. The quebracho forests contain a variety of trees, but the quebracho colorado (*Schinopsis lorentzii*) yields most of the tannin extract, and the quebracho blanco (*Aspidosperma quebracho blanco*) supplies most of the lumber, though the quebracho colorado may be used for construction, posts, and ties. The former possesses a far higher tannin content than most woods of the northern hemisphere (twice as much as hemlock).

Natural conditions seem to be most favorable for the tree in the southeastern part of the region. The best stands of timber grow where temperatures rarely exceed 105° F. and seldom drop below 30° F. The existence of vast stretches of level lands, which drain with sufficient rapidity to do away with long inundation and slowly enough to furnish sufficient moisture for the tree, accounts for the excellent stands in this section; while these areas are flooded at times, the water does not become stagnant pools as it does away from the major drainage channels. The tree is rarely found on elevations 50 feet above the surrounding lowlands.

FIGURE 49.—The Paraguayan Chaco. Tall grasses in the foreground, tall palms and quebracho trees in the middle distance. While these grasses are excellent for grazing during the early part of the rainy season, they soon become hard and dry.

The tree avoids both the slightly elevated tracts which get very dry during the winter and the depressions occupied by permanent swamps. The moisture requirements of the trees seem to be quite exacting. Also, this area receives much more rain than the northwestern part. The portions of Formosa, Chaco, and Santa Fé in this part of the area contain 95 per cent of the quebracho colorado of the entire region.

The industry is carried on for the most part by corporations. The extract companies depend chiefly

upon their own vast timber holdings for a large proportion of the raw material, but they also purchase logs from small private organizations in the open market at times when they find it difficult to supply the factories from their holdings. Operations consist of two phases: (1) the cutting of the timber and the transportation of the logs, and (2) the manufacture and the exportation of the extract. The former is almost entirely in the hands of contractors, who work on a tonnage basis, and who supply all the equipment necessary.

Although the distribution of the trees within a short distance of the chief rivers and the location of the plants on the river banks favor the industry, it labors under several handicaps (Fig. 50): (1) poor land transportation; in wet weather the roads become almost bottomless channels of mud in a short time, (2) extremes of wet or dry weather which put a stop to all field operations; the former floods the lands, the latter causes a scarcity of water and pasture for the stock, (3) inefficient and indolent labor; though labor is plentiful the worker is irresponsible and must be supervised constantly, (4) insects, especially mosquitoes and sand fleas, (5) malaria, and (6) forest fires.

Only a little more than a quarter of a century old, the industry has developed at a rapid rate (Table III). At present the annual rate of exploitation is somewhat more than one million tons of quebracho logs, cut from about 500,000 acres. Recent estimates place the life of the industry at about 40 years at the present rate of exploitation. However, these do not take into account the working of lower and lower-grade materials as tannin extract becomes more expensive. At present, only the heartwood, which yields from 25 to 30 per cent tannin, is used; the sapwood (outer section) which would give 3 to 4 per cent of tannin, and the bark which would give 6 to 8 per cent, are thrown away.[5] Obviously as the timber is exhausted, these will be employed as sources of tannin. Furthermore, as the quebracho grows rapidly, new stands of timber, under a forest policy, may lengthen materially the life of the industry.

TABLE III
EXPORTS OF QUEBRACHO FROM ARGENTINA AND PARAGUAY
(In Metric tons)

	Argentina		*Paraguay*	
	Quebracho Extract	Quebracho Logs	Quebracho Extract	Quebracho Logs
1893 ...	[1]	63,297		
1894 ...	[1]	74,358		
1895 ...	402	172,949	(For the years 1893–1906 inclusive no records are available so far as the author has been able to determine.)	
1896 ...	684	83,266		
1897 ...	1,205	135,675		
1898 ...	1,192	188,260		
1899 ...	3,172	159,376		
1900 ...	5,957	239,836		
1901 ...	4,310	198,919		
1902 ...	9,099	245,723		
1903 ...	12,040	200,201		
1904 ...	20,111	252,723		
1905 ...	29,408	285,879		
1906 ...	30,839	230,100		
1907 ...	28,195	246,514	9,209	9,000
1908 ...	48,162	254,571	13,136	18,106
1909 ...	55,493	294,722	10,680	[1]
1910 ...	53,231	341,969	11,538	14,888
1911 ...	68,431	438,216	8,121	17,185
1912 ...	74,910	279,342	7,298	3,689
1913 ...	79,684	383,964	11,721	13,067
1914 ...	80,153	291,942	12,710	8,417
1915 ...	100,213	209,679	18,307	2,322
1916 ...	97,574	161,734	21,136	1,006
1917 ...	90,777	133,170	29,899	1,645
1918 ...	124,710	[1]	19,096	523
1919 ...	139,700	54,600	32,976	1,668
1920 ...	122,800	56,600	24,331	269
1921 ...	94,300	40,000	29,356	[1]
1922 ...	167,800	124,800	37,800	1,614
1923 ...	204,000	123,800	35,139	5,271
1924 ...	180,912	94,037	31,685	2,602
1925 ...	214,183	131,520	64,662	2,374
1926 ...	202,608	81,194		
1927 ...	198,807	129,104		

[1] No record.

THE LIVE STOCK INDUSTRY

In contrast to the recent quebracho industry, the grazing of animals in the Chaco is of long standing. Indians have grazed cattle and horses in the Chaco since the seventeenth

[5] Chestnut wood contains only 3 to 6 per cent of tannin, and oak bark frequently yields as low as 8 per cent, yet both are profitably used as sources of tannin.

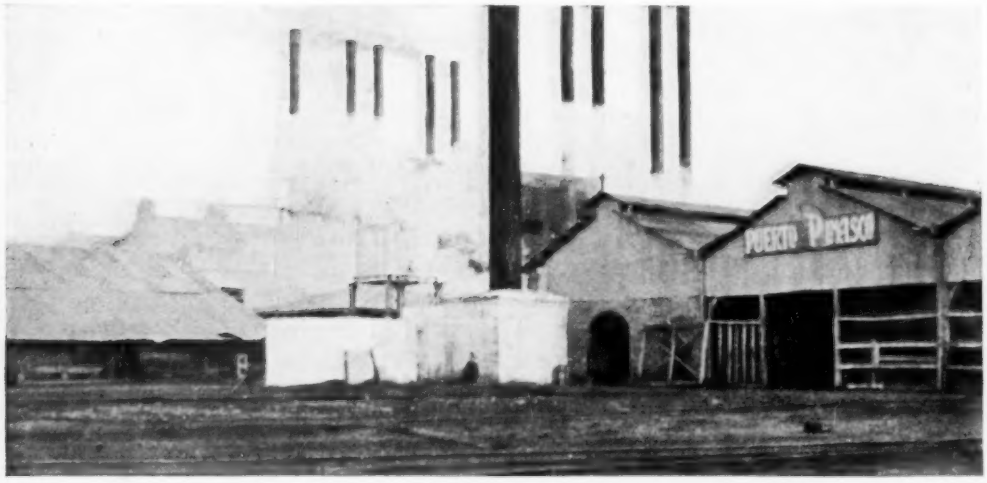

FIGURE 50.—An extract factory on the Paraguayan River at Puerto Pinasco, where quebracho logs are converted into tannin. The location of the forests near the streams and the mills on the rivers affords cheap transportation for the extract and the logs to ocean ports.

century. They found forage fairly plentiful in the grassland sections and even in the forest areas. Pastoral colonization took place first in the western grassland portion of the Chaco. Here cattle were raised for a local supply of meat, or were driven in large numbers to the oases of western Argentina or across the Andes to the desert of Northern Chile. The eastern chaco, the forested section, has many cattle, used primarily for draft purposes, but also for a local supply of meat and for extract at a few plants (Fig. 51).

While the Chaco, in some ways, may favor pastoral activities, the many handicaps it faces have prevented a significant development of the grazing industry. In the first place, the Chaco is remote, and lacks transportation facilities; the demands of the major market for chilled and frozen beef have been met by central Argentina and Uruguay, areas far more favored than the Chaco. The Chaco grasses, green, small, and tender at the beginning of the rainy season, soon become tall, hard, and of decreasing value as forage with the approach of the dry season. The whole area lies in a tick zone, so that only hardy and inferior cattle can be raised (Fig. 52); pure-bred stock brought in soon succumb to fever. The hoof-and-mouth disease is endemic. Blow fly causes the loss of a considerable percentage of the calves. In vast areas a scarcity of water exists at times during the dry season as stream courses dry up or as pools of water become too brackish for drinking purposes. Few ranges are fenced as on the Pampa, and little is done to regulate breeding or to improve the herds. Under this combination of handicaps the cattle industry does not promise much in the near future, but as more of the vast cattle *estancias* of central Argentina are converted into cereal lands, the Chaco in time may witness a marked development of the cattle industry.

CROP PRODUCTION

From the standpoint of crop production, the Chaco as a whole is less important than it is for cattle raising or for the quebracho industry. Agricultural development does not follow

FIGURE 51.—Chaco cattle being loaded on lighters at Puerto Pinasco, Paraguay, for transportation south to the packing houses and extract plant at San Antonio, a 36 hours' run.

the quebracho industry, except as it may supply that industry because the natural conditions do not favor colonization. Temperature, rainfall, relief, soil, and drainage locally may favor the production of a wide range of subtropical crops, but the production of the region is relatively small because of small population, restricted market at the cattle *estancias* or the extract plants, poor transportation facilities and ports, and unfavorable natural conditions over vast areas, and nearly every year, from November to February, locusts arrive in great numbers and devour crops, garden truck, and even the tender grasses. The western half of the Chaco is subject to long and severe droughts; much of the region has a

FIGURE 52.—A herd of breeding cows in the Paraguayan Chaco. Medium- to low-grade cattle in this region are utilized chiefly for the manufacture of beef extract. A few are killed for the lowest grade of European frozen beef, and some are utilized in the preparation of jerked beef. (Courtesy of George H. Kingsland.)

thin grayish soil, underlaid with an impermeable stratum of hard clay; a great deal of the water is saline; other areas flooded regularly for long periods preclude crop production. The region as a whole is deficient in foodstuffs. But one area in the Chaco has witnessed a marked development in the production of cotton. It is an indication of what may happen with the increase of population and the construction of railway lines in other parts of the Chaco.

THE CHACO-COTTON SUB-REGION

The cultivation of cotton in the Chaco is of recent development and has been fostered greatly by the government. A government railway line serves the entire sub-region (Fig. 53). Government agencies distribute free to farmers seed that has been carefully selected and treated. Local banks extend loans to farmers. Travelling experts teach the new comers modern methods of cultivation and picking. Government pamphlets are widely distributed in the region. Emigrants are being sent to this area where they may secure land at a nominal fee. Recently steps have been taken to introduce better types of cotton and to grade the crop.

For most of the sub-region fertile soils in the open grass land stretches, a growing season of ten months, annual precipitation of 30 to 50 inches distributed mostly in the spring and summer, a dry harvest period, the absence of crab, Johnson, and other grasses that require much work with the hoe in keeping the crop clean, cheap land, cheap work animals and feed, cheap labor, and water transportation all favor the production of cotton.

But the region has its handicaps. Locusts by the millions swarm south

FIGURE 53.—Almost all of the cotton area in northern Argentina lies within 50 miles of the government railway.

across the zone and often make a clean sweep of the early stands, making replanting necessary, with the consequent danger from early fall frosts; cotton fields are protected from locusts by sheet iron barriers and ditches often provided by the national government. The leaf worm, spread over the entire area, causes considerable damage; ants cause losses in many districts by building huge nests. The pink boll weevil, though confined to local districts, constitutes the most serious pest. The cotton wilt is also present. Immigrant farmers, lacking adequate knowledge of the industry, form a major handicap.

In spite of the aforementioned handicaps cotton culture, only of very local importance until 1900, has expanded rapidly. In 1926 the total acreage reached nearly 275,000 acres (but it dropped in 1927 to 200,000 acres).

The cotton cultivated is known as the Chaco type, a hybrid of upland American and Sea-Island. Fibers vary in length; 40 per cent of the fibers are between 5/8 and 7/8 of an inch; 35 per cent, 1 inch; 25 per cent between 1 and 1 1/8 inches. While the fibers have excellent texture, much cotton comes dirty and discolored. Yields are quite high; in 1925–1926 they averaged 40 per cent higher than those of the United States; the yield that year in Argentina was 241 pounds per acre. Little or no rotation of crops takes place.

In contrast to other crops in Argentina, most of the cotton is grown by the small farmer; a majority of the farms are cared for by the planter, his family, and only occasional help. But on a few large plantations, Indian and immigrant labor is required. During the picking season some 25,000 Indians migrate to the cotton fields. The national government wishes to keep the industry chiefly in the hands of the small immigrant planter, but in recent years large estates have undertaken cotton culture with migrant labor.

Although cotton occupies but a part of the sub-region and the sub-region a fraction of the Chaco, the possibilities for the extension of cotton culture seem great. Most certainly vast areas in the Chaco are well adapted for cotton cultivation, and a greater expansion of the cotton sub-region only awaits an increased demand, improved transportation facilities, more effective combating of locusts, the pink boll weevil and plant diseases, and a larger and more stable labor supply.

SUB-TROPICAL AND YERBA MATÉ FOREST

Bordered on the north, west, and south by grazing lands and on the east by farming regions, the Sub-tropical and Yerba Maté Forest has little grazing or crop production. Only here and there do farm clearings and logging operations and small grassland stretches break the continuity of the forest expanse.

Physiographically, largely a part of the Brazilian Highland, the region has an undulating surface, broken by the broad level, swampy flats along most of the major streams, across which transportation and communication are difficult. Lying on the border of the tropics and nowhere more than 3,000 feet above the level of the sea, the region has sub-tropical temperatures, similar to those of the Chaco. In the southern part, mean monthly temperatures range between 55° and 80° F. The annual rainfall of 60 to 80 inches is fairly evenly distributed throughout the year; no distinct dry season, as in the Matto Grosso to the north or the Chaco to the west arrests the growth of plants (Figs. 2 to 6).[6] As a result of favorable temperatures, rainfall, drainage, and soils, the region supports a valuable forest growth. In the north and east the open forests are composed almost entirely of pines (*Araucaria brasiliana*); in the west and south the pines are confined more to the upland portions, being replaced on the slopes and floors of the valleys by a more tropical forest of hardwoods and underbrush.

[6] ECONOMIC GEOGRAPHY, Vol. 4, No. 1: "Agricultural Regions of South America," by the author.

THE LUMBER INDUSTRY

The lumber industry of the region consists of the exploitation of the Paraná pine in the east and the production of subtropical hardwoods and other forest products in the west and south.

This region in the Paraná pine holds the largest stand of commercial softwood timber in South America. The pure stands of the Paraná pine afford a timber reserve of 860,000,000,000 board feet, of which at least 300,000,000,000 feet are suitable for high-grade commercial purposes.

The Paraná pine, a tall, straight tree with a wide flattened crown, attains a diameter at maturity of 2 to 7 feet and a height of 80 to 130 feet. Mature trees have long, clean boles with little taper except in the crown log, which also has most of the branches. It gives a yellow, soft, flexible, elastic, and easily worked wood. But it warps and splits readily unless well seasoned. It is used in a variety of ways, but decays rapidly in contact with the ground.

Although of recent development, the Paraná pine industry has expanded rapidly in recent years, owing to the lack of other soft lumber and structural timber in this part of the continent. The annual cut now amounts to about 130,000,000 board feet. Most of this comes from the Brazilian section of the region for in the other countries the Paraná pine stands are, for the most part, some distance from the rivers and good roads and rail transport have not been provided. About two-thirds of the output is consumed in Brazil, the other in Argentina and Uruguay; little is used as yet, in Paraguay, as the *cedro* takes its place. Out of approximately 350 mills in this region, not more than four are large modern plants with the equipment needed for the manufacture of all kinds of lumber. In general, lumbering, milling methods, and the curing of lumber are crude. Some vast land holdings prevail, and many range in size from 1,000 to 30,000 acres.

While the industry faces handicaps in poor transport facilities (the logs when green will not float), inadequate equipment, poor methods of lumbering, milling, and curing, and lack of labor, it may expand considerably for these disadvantages may be overcome. With large stands of excellent timber, it is expected that the industry will expand, in the near future, to the point of supplying most of the lumber products of southern Brazil, Uruguay, and Argentina.

In the Argentine and Paraguayan portions of the region, the production of other woods is more important than the cutting of Paraná pine. Among the woods utilized are quebracho, *curupay*, *lapacho*, and the Spanish cedar; the cedar is the most important. Its wood, rose-colored, fine-grained, and rather soft, is in demand for structural timber, lumber, and furniture. All these woods are found in the lowlands bordering the streams and thus can be worked more easily than the Paraná pine, which in this section is restricted more to the elevated lands.

YERBA MATÉ

Yerba Maté (*Ilex paraguayensis*, or South American Holly), the basis of an extensive industry, grows in all parts of this region, except the low, swampy lands bordering the streams. It is an evergreen, attaining a height of 12 to 25 feet in the natural state in the forest. Bushy in habit, it re-

sembles somewhat an orange tree. Its chief product, the leaf, is deep green in color and glossy.

The plant, for the growth of a large quantity of small tender leaves, finds here favorable conditions. They include a heavy precipitation, fairly well distributed throughout the year, high temperatures, excellent drainage, fertile red soils, and a forest cover which protects the young plants from intense sunlight.

Yerba maté formerly was gathered in large part from trees growing in the wild state by bands of Indians, who entered the forest in considerable numbers at the beginning of each cutting season. Under the destructive methods employed, the number of trees decreased rapidly. These methods, an increased demand, and high prices led to extensive systematic cultivation of the plant in several parts of the region. Thus, the production of *yerba maté* has become in a true sense, an agricultural activity. However, after the seedlings are transplanted from the nursery to the plantation, and after the trees are three years old, the plantation receives little attention, except that brush and trees may be chopped out, and the trees pruned at intervals.

The harvest season lasts, in general, about six months; at that time the pruners enter the plantations and the forest, cut the branches bearing the tender green leaves, roast and dry the leaves over fires or on some of the large plantations in special pans set in a brick furnace, and pack them for shipment. Since most of the *yerbales* are located on well-drained uplands away from the streams, the prepared *yerba maté* moves over muddy trails or roads on the backs of human porters, on mules, or on ox carts to the rivers or the railways, the chief outlets. Although *yerba maté* grows throughout the region, its exploitation is confined for the most part to the margins of this vast area. The chief sections of production include a broad strip through central Paraná, Santa Catharina, and northern Río Grande do Sul, south central Misiones, and east central Paraguay.

While *yerba maté* is consumed in large quantities in Paraguay, northern Argentina, Southern Brazil, and Uruguay, several conditions, chiefly economic, retard its more extensive cultivation in this region. They include a small supply of inefficient labor; poor methods of cutting, drying, roasting, and packing; inadequate transportation facilities; and the lack of equipment and organization to insure a uniformly high product for the consumer.

CROPS AND ANIMALS

Although Paraná pine, subtropical hardwood, and *yerba maté* dominate the region, crop production and stock raising are important locally throughout the region. Agriculture is confined largely to the scattered forest clearings, where high temperatures, much moisture, fertile red soils derived from shaley sandstones and old rocks of the Brazilian highland give fairly good yields in spite of crude methods of tillage, with little or no modern implements. It consists chiefly of subsistance agriculture, the production of foods and raw materials for home consumption; one exception prevails in the production or gathering of oranges, lemons, and limes for export and the collection of the leaves of the bitter orange tree (*Citrus bigaradia*), and distilling them for the "oil of petit grain" used in the manufacture of perfumes. A variety of crops is grown—corn, the

chief one, and well suited to the environmental conditions and the methods of pioneer farming, cassava, beans, rice, tobacco, bananas, and citrus fruits. The cattle, of poor quality and subject to Texas fever, hoof-and-mouth disease and blow fly, are employed chiefly for transportation purposes; they are used also for a local supply of meat. Little development of crop production or the raising of animals can be expected in this area until (1) the better areas to the east and south are more intensively utilized, (2) transportation to and in the region has been improved, and (3) until the population becomes greater and more advanced.

This region, in different parts, has been the scene of colonization, a movement that promises to gain momentum. Pioneers have moved from the German, Italian, Polish, and Basque colonies of eastern Paraná, Santa Catharina, and Río Grande do Sul into this frontier region; in Misiones colonists have penetrated the forests in two areas: a group above Posadas on Río Paraná (Candelaria, Corpus, San Ignacio, and Santa Ana) and the other on the slopes of the hills in south central Misiones (Bompland, Cerro Cora, San Cristóbal, Meking and others); in Paraguay from Villa Rica and Encarnación as centers, foresters, and colonists have begun the exploitation of this region. With population and the improvement of transportation, the Paraná pine will go down by the woodman's axe and forest fires; *yerbales* will spring up; and crops will grow and animals will graze in the expanding forest clearings. However, a rapid development may not be expected until bordering regions have been more utilized.

GENERAL FARMING REGION OF SOUTHERN BRAZIL

The general crop and animal region of Southern Brazil extends from about 24½° S. latitude in the State of Sao Paulo to 30° S. in northern Río Grande do Sul and from 250 to 350 miles inland.

A long narrow coastal plain less than 600 feet above sea level borders most of the region on the east. Back of the coastal plain, the ranges of the Serra do Mar or Serra Geral rise to 2,000 feet, and in places to 5,000 feet. This range forms the divide beyond which the streams flow between the undulating ridges of the old Brazilian upland towards the Paraná and the Uruguay. To the east, short, rapid streams descend in cataracts to the coastal belt.

The region, as a whole, has a subtropical climate. Though the narrow eastern lowland is rainy, hot, and rather unhealthful, it is productive. To the west the Serra do Mar and the Plateau afford more comfortable conditions; here the temperatures at 2,000 feet or above range from 99° F. in the hottest season to freezing on the coldest days. For the entire region an annual rainfall of from 60 to 80 inches is fairly well distributed throughout the year (Figs. 2 to 6).[7]

Heavy rain and high temperatures on the coastal plain and the eastern flanks of the mountains support a tropical forest; in the highland area the vegetation is dominated by the *araucaria* forest. In the latter region much of the stand has gone down in the face of fires and the axe of the colonist, for this area has been the

[7] ECONOMIC GEOGRAPHY, Vol. 4, No. 1: "Agricultural Regions of South America," by the author.

scene of active colonization by the Germans, Poles, Italians, and Swiss.

Like most sections of this part of the continent, the region lacks adequate transportation facilities. The entire railway mileage consists of a section of the railway from Montevideo to Río de Janeiro and a few short lines from the coast to a highland section. Heavy rains, a forest cover, rolling to rough relief, small capital and isolated settlements have hindered the construction of good roads, so that few exist; the rivers cannot be used for transportation. These same conditions have restricted agricultural activities, and especially the marketing of agricultural produce. As a result, the communities of this region consist largely of self-sufficient isolated settlements; they market little and buy little from the outside.

As indicated, in the name, the region is one of general farming; nearly every farm grows a variety of crops and raises a variety of animals, in a frontier-like fashion, where little machinery is used and the methods of farming are crude. Along the western margin, the production of Paraná pine and *yerba maté* are important activities also. Much of the land recently cleared for cultivation is full of stumps. In contrast to the cattle *estancias* of Río Grande do Sul and the coffee *fazendas* of Sao Paulo, rather small farms prevail in this region.

In the region about 690,000 acres are in cultivated land, of which 42 per cent is in corn, 15 per cent in beans, 7 per cent in cassava, 5.5 per cent equally in rice, sugar, coffee, and wheat, and 15 per cent in potatoes, cotton, and other minor crops Of the land in agricultural holdings, more than half is in pasture or woodlots.

Corn, the leading crop in the area,

FIGURE 54.—Though corn is more widely grown in other parts of Brazil, it occupies a more important place among the crops of this region than it does any where else in the Republic, with the possible exception of some small patches in the Amazon region.

fits in well with natural and economic conditions (Fig. 54).[8] It is a fairly productive crop, even with poor methods of tillage; much of it may be planted among girdled trees or standing stumps and give good yields with little care after planting. It may be used in a variety of ways as food for man, and as feed for beasts. The heavy rainfall, fertile red soils, and high temperatures insure a good growth, but the lack of a distinct dry harvest period causes a soft corn, that must be dried in the sun on open earthen or cement floors. Consequently, little or no corn is exported; it will not ship well.

Beans, the second crop in the region from the standpoint of area, are produced especially in two districts,

[8] The writer is indebted to Mabel Ripley for the preparation of the dot maps of Brazil and for assistance in the delineation of the agricultural regions of that Republic. In the work on the maps, Miss Ripley discovered an accurate method of distributing the dots by small political divisions without the community boundaries. The statistics for all the Brazilian maps were compiled from *Recenseamento do Brazil*, 1920, Vol. III, (*2ª Parte*) *Agricultura*, pp. 20–109; 246–335. Directoria Geral de Estadistica, Río de Janeiro, 1925.

FIGURE 55.—Beans occupy a rather important place in the diet of the lower classes from Minas Geraes south.

northern Río Grande do Sul and eastern Paraná (Fig. 55). While a variety is grown, the common bean is a black type. In a few places beans are planted alone as the only crop, but most of them grow with corn. Most varieties consist of climbers or pole beans.

The cassava tuber, a staple food of the hot parts of Brazil, is grown in large quantities in this region (Fig. 56). Two principal kinds are produced, a poisonous kind, and a non-poisonous kind; the former is used for making flour (*farina*) and starch; the latter for food and feed and also for starch. The plant grows up to 3,000 feet elevation and seems to do best on light friable soils. The roots mature in eight to twenty-four months; the commercial crop, for tapioca, grows for two years. Cassava yields large crops with little attention.

Rice, sugar, wheat, and Irish potatoes are all local supply crops. They occupy a significant place in the diet of the people. Both lowland and upland rice are cultivated by small farmers in the region; low temperatures, and an uncertain supply of water restrict rice culture. Crude methods of production prevail; yields per acre are low. Planting takes place from August to December and the harvest from January to June.

Nearly all of Brazil's wheat grows in the State of Río Grande do Sul, as rusts and fungus diseases preclude its production in the hot, moist regions; even here conditions are far from ideal. As a result of climatic conditions, only soft wheats are produced. Yet, this region supplies about one-third of the nation's requirements. Wheat culture is expanding with national and state aid in producing new varieties of wheat more suited to moist, hot conditions and in combating insect pests and diseases. But poor agriculture methods, inadequate transportation facilities, and competition with cheaper wheats from temperate regions retard greatly wheat culture.

FIGURE 56.—Cassava, although produced in all Brazil, shows three areas of marked density—Southern Brazil, Northeastern Brazil, and the Lower Amazon.

Potatoes, owing to their large productivity per acre, are more important than the areal comparison with

other crops would indicate (Fig. 57). The potato is confined chiefly to the highland portions of the region where cool temperatures prevail at the time the tubers are forming. Potato diseases, resulting from high temperatures and moist conditions, restrict their cultivation. Like other crops in the region, potatoes receive little attention after planting.

As with crops, a variety of animals finds a place in the general farming of this region—swine, cattle, horses, mules, and a few sheep and goats. In contrast to the vast herds and flocks of southern Río Grande do Sul, each farm has a number of different animals.

FIGURE 57.—The Irish potato is confined largely to Southern Brazil, as moist conditions and high temperatures of the more tropical regions do not favor its production in other sections.

Swine, adapted to pioneer conditions, find abundant foods. Many root for themselves in the forests or the woodlots; corn and roots are fed to them. They provide a cheap food supply that can be prepared and kept by the small farmer. In this region, swine outnumber cattle one and one-half times (Fig. 58). Here, swine suffer less from parasites and diseases than in the more tropical parts of the republic. The animals consist of a poor type; they are thin, large boned, and difficult to fatten. Allowed a free range in the woods, they are rounded in for butchering at certain intervals. Breeding is a matter of chance; no selection of stock is made.

Cattle constitute about 30 per cent of the animals of this region, but they are few in number compared to Southern Río Grande do Sul. They form the chief draft animals, being better adapted to the rough muddy roads and to the hot, moist climate than the horse. Most of the cattle have been bred for draft purposes, but they also furnish a local supply of fresh beef and quantities of *tasajo* or dried beef. Handicaps to the development of a high-grade beef animal in the region include few purebred stock, poor transportation, and refrigeration facilities, a lack of a good supply of excellent forage, and insects and diseases. On the other hand, the stock can graze in the open throughout the year.

The sheep district of Brazil lies largely to the south and the goat district chiefly to the north of the General Farming Region, but they comprise 8 per cent of the livestock of the region. Here, sheep do not grow a heavy fleece and after introducing sheep, the wool rapidly decreases in quality, owing to high temperatures and moist conditions. A little mutton varies the diet of the people, but pork is preferred. Goats are kept for milk in small flocks by farmers and by people living in the villages.

Only in the pioneer stage, the General Farming Region has favorable natural conditions, for a marked agricultural expansion. However, better transportation facilities and

FIGURE 58.—Although swine are raised in every state of Brazil, they are concentrated in the southeastern part of the country.

refrigeration must be provided, crops and animals improved, better agricultural implements put into use, methods of farming advanced, and more effective means of combating insect pests and diseases employed, before a marked development can take place.

(Another instalment of this article will appear in a later issue)

EGYPT IS THE NILE

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NO one can say just how long the valley of the Nile has been under cultivation, but surely agriculture in this region dates back at least seven thousand years. Protected from outside interference, in large measure, by the desert on either hand; freed, by the same natural barrier, from the temptation to lead a nomadic life, the Egyptians turned early to tilling the soil, and established themselves as an agricultural people even before the dawn of history. With a sedentary life came the opportunity to produce and store up wealth, and wealth made for leisure—leisure in the sense of time that might be devoted to pursuits other than providing the mere necessities of life—and thus we have the beginnings of civilization. But the achievement of one of the greatest ancient civilizations in no wise affected Egypt's dependence upon agriculture—a dependence freely acknowledged from the beginning. Her geographic heritage made her an agricultural country. This she has always been and will continue to be to the end of time. And the early development of irrigation shows that the Egyptians were not slow to recognize this fact.

Geographic Setting

Students of geographical influence have found in Egypt abundant evidence of the close relationship existing between the social and economic life of a people and their physical surroundings. As described by its political boundaries, Modern Egypt [1] occupies the larger part of northeastern Africa, extending from 5° to 31° North Latitude. Two-thirds or more of it lies within the tropic zone and the other third immediately adjacent in the north temperate zone, the total area approximating 1,400,000 square miles. In all of this territory the most significant single physical factor is the Nile River. Herodotus was not exaggerating when he wrote, some twenty-five hundred years ago, "Egypt is the Nile, and the Nile is Egypt." All that history tells us of Egypt serves only to prove his statement. It was the Nile that enabled the Egyptians to supply the tribes of ancient Judea with grain in time of scarcity. It was the Nile that made Egypt the granary of needy peoples in later times. And it is the Nile which today renders fertile the only parts of Egypt which are productive of wealth; namely, the Nile Valley and the Delta of the Nile.

As we examine this region today, we are bound to note a permanence of things that is unquestionably the result of this great river. By its economic possibilities the development of a nation is largely determined,

[1] Modern Egypt includes both Egypt Proper and Anglo-Egyptian Sudan, which have in common not only their dependence upon the Nile, but their subjection to Great Britain, in the matter of political control. Egypt Proper is the northernmost of the two, and is of vastly greater importance from the productive point of view, though only one-third as large as the Sudan. The present study concerns itself chiefly with Egypt Proper, since the economic exploitation of the Sudan has progressed but slightly.

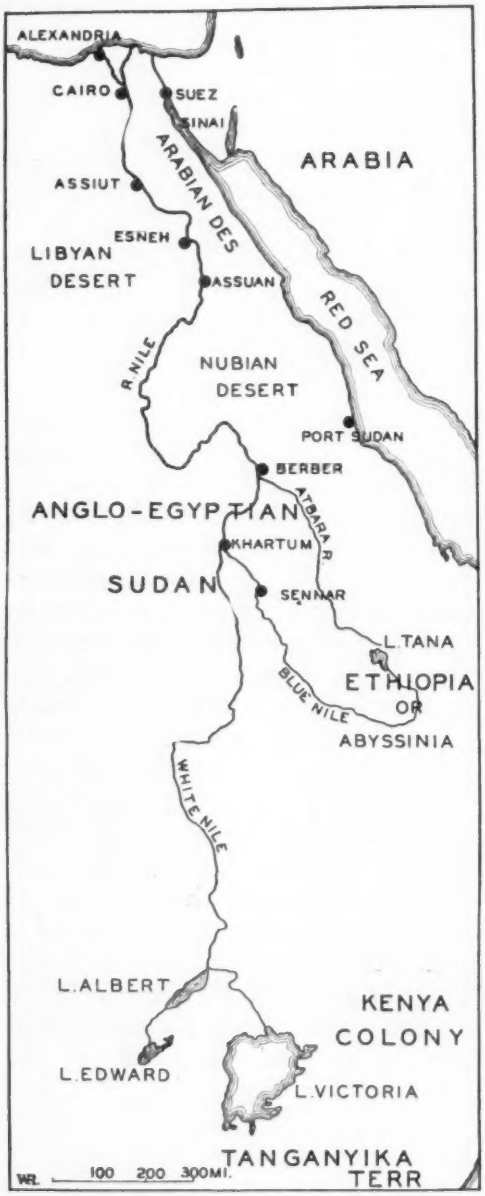

FIGURE 1.—Modern Egypt includes both Egypt Proper (to the north) and Anglo-Egyptian Sudan. The Sudan is of slight economic importance. The present paper tells the story of the development of Egypt Proper through progress in irrigation.

unless it can command outside resources. The Nile has always controlled the economic life of Egypt. It was the Nile that made of her an agricultural nation, and for centuries its flow limited the extent of possible cultivation. Until great irrigation projects were put into effect, about twenty-five years ago, the amount of land in Egypt available for farming had been practically stationary, being fixed by the annual overflow of the river. At an early date this land was brought to a high state of cultivation; labor was plentiful and cheap, and intensive farming was practised. Only slight progress has been made in the actual methods of agriculture, and consequently the peasant of today lives much the same life as did the serf of the Pharoahs. "As a whole," says Professor Shaler, "this land exhibits a singularly ancient adjustment of a people to their environment, one so early accomplished that there has been but little change in their customs or numbers for at least four millenniums."

LAND OF LITTLE RAIN

The importance of the Nile to Egypt becomes apparent with an understanding of the physical characteristics of that country. A glance at a rainfall map shows that the northern third of Africa is almost wholly desert land. Turning to the northeast corner of the continent, we find the desert belt broken by the fertile Nile Valley, which extends throughout the length of Modern Egypt. At some points the surface of the river is many feet below the level of the surrounding land, and at others the deposits of silt have built up the river bed and banks to a height considerably greater than that of the adjacent plain. Consequently, the irrigated belt is at times narrow, due to difficulty in getting the water to the land; and, again, it broadens out to an average width of ten to fifteen miles. To the east lies the Nu-

bian Desert and a small portion of the Arabian Desert, occupying all of the territory between the Nile and the Red Sea, and varying in width from 90 to 350 miles. On the west, the Libyan Desert spreads out till it joins the great Sahara.

The physical factor that produced the Sahara is responsible also for the deserts bordering the Nile: that is, in the main, the action of the northeast trade winds which, originating as Mediterranean coast, has an annual rainfall of about eight inches; Cairo, 120 miles farther south, has but 1.5 inches; and portions of Egypt yet more remote from the Mediterranean are practically rainless.

COURSE OF THE NILE

But if Nature has dealt sparingly with Northern Africa in the matter of precipitation, she has been more than generous with the equatorial regions

FIGURE 2.—The Nile in flood. At the right is the embankment of the Ibrahimia Canal. The dike beyond the water is an old railroad right of way (the present right of way parallels this, but is a hundred yards farther on). In the distance is the Libyan Desert. (Courtesy of Board of Foreign Missions, United Presbyterian Church.)

they do at about 28° N. Latitude, near the northern boundary of the continent, and warming as they approach the Equator, take up but do not redeposit moisture. There is as a result, almost no rainfall. The minimum precipitation necessary for carrying on agriculture without artificial irrigation, even in temperate climates, is about 20 inches. No part of Egypt is so highly favored. Alexandria, due to its location on the immediately to the south of Anglo-Egyptian Sudan. The warm, rain-laden winds from the Indian Ocean sweep against the mountains of Kenya and Tanganyika, and the Ethiopian highlands. Cooled by the contact, they give up most of their moisture. Consequently, these countries are amply provided with water, as is shown by the presence of large lakes. It is in the greatest of these lakes, Lake Victoria of Kenya

and Tanganyika, that the Nile has its source. Flowing north, it is swollen by tributaries forming the White Nile. At Khartum, in the Sudan, it is joined by the Blue Nile flowing from the southern highlands of Ethiopia, and 200 miles farther on, near the town of Berber, by the Atbara, which drains the northern highlands of Ethiopia. From this point, it flows 1,800 miles to the Mediterranean without being added to by any other tributaries.

FIGURE 3.—The canal is low, and the girls fill their jars by splashing the water into them with their hands. Why not use a quart measure? Oh, this is the "fellah" custom. The life in the Delta depends upon these canals, now regulated at will. (Courtesy of Board of Foreign Missions, United Presbyterian Church.)

This, then, is the river system that saves Egypt from the desert. First, it provides irrigation for the Nile Valley, a narrow strip of land varying in width from two to thirty miles, five or six miles being perhaps a fair average. Then, at Cairo, the river forms two branches which spread to such extent that when they reach the Mediterranean, 150 miles farther north, they are separated by 70 miles of coastline. Thus is formed the Delta of the Nile, and within the sides of this triangle is found the most productive soil in all of northern Africa.

Though the total area of Egypt Proper[2] is approximately 350,000 square miles, the cultivable and settled area (that is, the Nile Valley and the Delta) covers only about 12,000 square miles, an area slightly more than one-fourth that of the state of Pennsylvania. But so productive is this region that it is able to support a population of approximately 12,500,000, or 1,050 to the square mile; which is a tremendous achievement when contrasted with Belgium, the most densely populated of European countries, which has but 659 to the square mile. Moreover, Egypt Proper produces from her own soil very nearly all of the foodstuffs consumed by her population, and this despite the fact that she devotes one-third of her land to the growing of cotton, which is her chief money crop. Such a record is possible only because much of the soil, by reason of perennial irrigation and a twelve-month growing season, is made to yield two and even three crops a year.

SCARCITY OF MINERAL RESOURCES

Apart from her limited area of extremely productive land, Egypt has almost nothing in the way of natural resources. There are no known deposits of coal, and almost no iron. What little coal Egypt uses for power, she secures from Western Europe. Fortunately, the climate is such that artificial heat is almost unnecessary. Millet stalks are sometimes used by the natives for heating purposes. Slight quantities of copper have been mined in the Peninsula

[2] The figures given in this paragraph relate to Egypt Proper alone, since comparable data for the less well-developed Sudan are not obtainable.

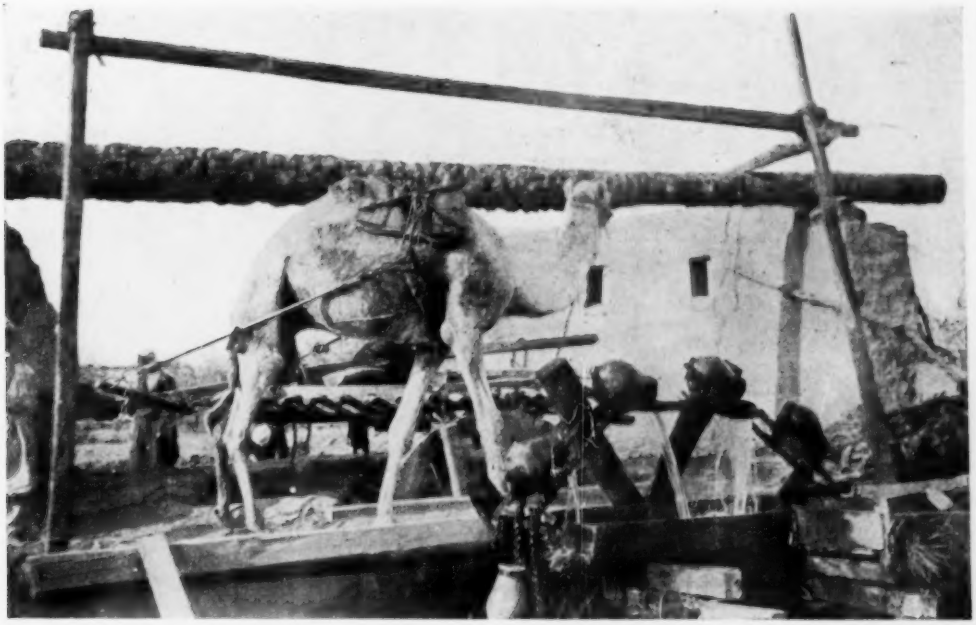

FIGURE 4.—A camel turning a water wheel for irrigation. An inexhaustible water supply can be obtained by sinking a well below the level of the Nile. (Courtesy of Board of Foreign Missions, United Presbyterian Church.)

of Sinai, and 150,000 tons of manganese iron ore were produced in 1924. Small amounts of gold, also, are mined. Petroleum has been discovered 190 miles south of Suez, close to the Red Sea coast, but not in sufficient quantity to be a factor in the world production of oil. There is a small annual output of phosphate rock. Sufficient salt for home consumption and unimportant exports is secured from the salt marshes of the Delta, and from the natural salt fields near Port Sudan on the Red Sea. Soda and alum are also found in the Delta in slight quantities.

Forests are unknown in Egypt Proper. The need of lumber for ships caused Egypt to make a conquest of Lebanon about 1470 B. C. In modern times she has met her requirements in a more peaceful manner by importing lumber from northern Europe and, prior to the Great War, from Austria-Hungary. The Sudan, however, has some forests of value. Along the Blue Nile are trees that yield fibers and tanning materials. From the forests of the White Nile come ebony, bamboo, and gum arabic. In 1923, the exports of gum arabic amounted to $5,000,000, and represented the most important item entering into the foreign trade of the Sudan. Ivory to the value of a quarter of a million dollars is exported annually from the Sudan.

NATURAL IRRIGATION

To draw up a list of Egypt's economic resources is almost to damn with faint praise, so little has she to boast of aside from her agricultural possibilities. It is not surprising, then, that the Egyptians, lacking the natural advantages for a wide variety of industries, should have concentrated their energies upon the soil

FIGURE 5.—Egyptian threshing floor. In the upper right corner a man is driving a yoke of oxen hitched to a small disc harrow that cuts the straw up into fine bits. This rig is driven round and round the pile of bundles which are fed slowly down to it. In the forecenter is seen the winnowing, and in the back center a pair of camels arriving with a new load to be stacked. (Courtesy of Board of Foreign Missions, United Presbyterian Church.)

itself. Agriculture was first carried on by means of natural irrigation. Due to the heavy rainfall in Ethiopia, the Nile begins to rise about the middle of June. Under primitive conditions, cultivation of the soil in Egypt depended upon the annual overflow of the river, which occurred in late summer or autumn. This overflow covered the nearby fields, and, subsiding, left there a rich fertilizing deposit carried down from the highlands. The deposit contained a large percentage of carbonate of lime, oxide of iron, and carbonate of soda. Land thus fertilized produces large crops. Moreover, there was no necessity for cultivation prior to seeding. Without bothering to plow the soil, the farmer proceeded to scatter the seed broadcast, and in due course reaped the harvest.

BASIN IRRIGATION

Such, we may assume, was the earliest form of irrigation. We cannot speak with assurance, since irrigation of this kind antedates recorded history. This irrigation was open, of course, to serious objections, and the desirability of controlling the flow must have been promptly recognized. The earliest records indicate the presence of a system of basin irrigation, very similar to that in use in much of Upper Egypt today. Instead of allowing the waters of the river to flow at will, dikes were built, canals were dug, and a network of channels led the water to strips of land that were not cultivable under the old "natural" irrigation. No definite date can be attached to this great improvement, but the classicists assure us that the beginning of the Nile irrigation system, in the sense of a great organized and unified method of controlling the inundation for irrigation purposes, falls in the third millennium, or about five thousand years ago.

Basin irrigation brought about not

FIGURE 6.—Egyptian harvesting machinery in motion. Taken in the fields near Assiut. (Courtesy of Board of Foreign Missions, United Presbyterian Church.)

only more extensive agriculture, but a greater return per acre, as well. By means of the embankments, the water could be held for a longer period (usually for about six weeks), and thus it was robbed of practically all of its rich sediment before being drained off. But basin irrigation is by no means perfect. As a rule it permits of but one crop each year from a piece of land, unless provision is made for the retention of surplus water to be "fed out" as required, in which case it virtually becomes "perennial" or perpetual irrigation. A second difficulty, and a serious one, is that of flooding the higher basins near the river. The Nile cuts its way through sandstone and limestone formations, and at the time of lowest water the river is at some places thirty or forty feet below the top of the bank. Many of the farmers count on lifting the flood water by the use of power pumps, or, more generally, by means of the "shaduf," a crude lifting device resembling the old well-sweep; but to provide sufficient water by such means, in a season of unusually low flood, demands the expenditure of an enormous amount of time and energy. Finally, basin irrigation does not afford protection against unexpectedly high floods. These, if sufficiently great, may cause considerable loss of life and property through the bursting of dikes and canals.

PERENNIAL IRRIGATION

Perennial irrigation had its beginning in 1820, while Mehemet Ali was reigning viceroy. This crafty ruler wanted a part in supplying the great demand for cotton that had resulted from the invention of machinery for the manufacture of cotton goods. He determined to produce cotton in Egypt. But cotton demanded more than annual irrigation. Therefore, Mehemet Ali built long, deep canals to hold the water until it was needed. Here was perennial irrigation, though of a very crude nature. Yet it revolutionized agriculture in Egypt. It made possible the production of cotton, and the harvesting of more than one yearly crop of selected agricultural products. From this time forth came rapid strides in Nile irrigation. In 1861, a great barrage or dam was constructed, the purpose of which was to hold back the river at the Delta and thus cause a wider overflow. As a consequence, the annual cotton crop increased to about five times its earlier figure. But it remained for the English to bring into Egypt the engineering skill and financial backing that would utilize to the fullest the waters of the river. Their first task was to increase greatly the capacity of the dam at the Delta. Next they built another dam half way between Cairo and the sea, at Zifta, which added 1,000,000 acres to the area available for cotton, and doubled the value of the cotton

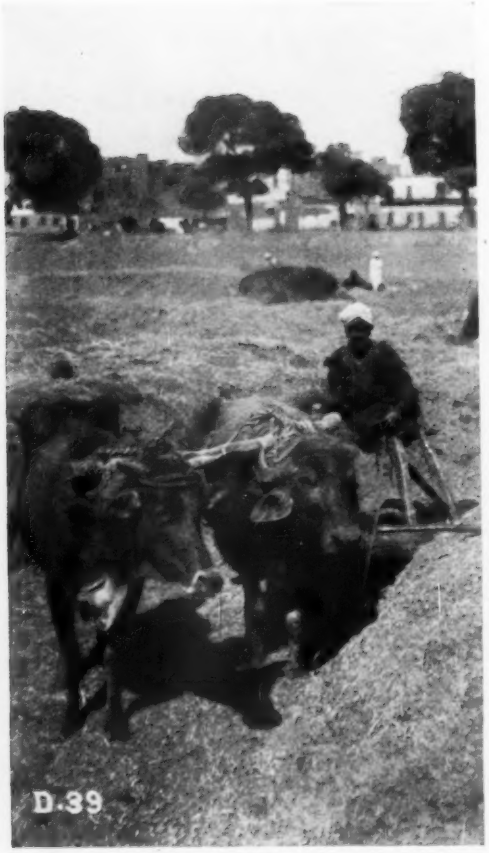

FIGURE 7.—The grain is threshed out by a simple machine resembling a disc harrow which is driven round the stack as the grain is worked down into its path. The grain is winnowed out from the chaff and cut straight and thrown back into the center of the circle, while the straw and chaff are gradually worked to the outside. Straw and chaff are then put into sacks and cared for almost as carefully as we care for the grain itself. (Courtesy of Board of Foreign Missions, United Presbyterian Church.)

crop. The success of these projects led to still others. Between 1900 and 1925, great dams were constructed at Assuan, Assiut, and Esneh. As an indication of the value of these dams, it is interesting to note that the dam at Assiut (250 miles above Cairo) saved its cost in a single season. This was in 1902, when the flood was very low; but with the water stored in the dam, crops worth $2,500,000 were saved.

MODERN IRRIGATION PRACTICE

The largest of the reservoirs already mentioned is that at Assuan. The construction of this dam began about 1900, but it was not until a dozen years later that its possibilities for storing water were realized; for in 1912 the level of the dam was raised and its capacity practically doubled. Assuan is 750 miles from the Mediterranean, just below the First Cataract of the river. Here, the Nile cuts through a bed of granite. On this solid foundation was built the Assuan Reservoir, a structure of granite 6,400 feet long, rising 100 feet about its foundations. An important feature of the dam is the provision of sluices, which permit either the retention or the unimpeded flow of the water, as may be necessary. During the rush of silt-laden waters from the Ethiopian highlands, beginning usually in June, the floodgates are left open, for the double purpose of keeping the reservoir free from silt and allowing the sediment to enrich the lower country, as it has

FIGURE 8.—Descended from the ancient Egyptian "kine," this is Egypt's most promising animal. Yearly production of milk is about 4,000 pounds each, and the milk is about one-fifth richer in various solids than ordinary cow's milk. Selection and improvement of this animal is to be undertaken by Assiut College Agricultural Department. (Courtesy of Board of Foreign Missions, United Presbyterian Church.)

done for centuries. By the first of December, however, the muddy flow (for which the rainy season in Ethiopia is responsible) has practically ceased, so that the Nile is now dependent in the main upon the continuous flow from the region of Lake Victoria through the White Nile. This water contains very little sediment, and the flood-gates may now be closed without encountering either of the objections which would have been present several months earlier. The sluices are closed gradually, in order that sufficient water for irrigation purposes may be allowed to escape. Ordinarily the dam is filled to capacity by March first. The river may be so low by April that it is necessary to supplement its flow with storage water from the reservoir. And from this time until the flood season in June, or later, irrigation is carried on largely with dammed-up water, which in the case of the Assuan Dam is backed up the river for nearly two hundred miles.

FIGURE 9.—Threshing wheat. When the straw has been ground up fine, it is separated from the wheat by tossing it up in the wind. The straw thus separated is also fed to animals. "Thou shalt not muzzle the ox that treadeth out the corn." (Courtesy of Board of Foreign Missions, United Presbyterian Church.)

It is estimated that a flow of 32,000 cubic feet of water per second throughout the year is necessary to provide perennial irrigation for the region of the Nile. Since the river supplies a constant flow of only 8,000 cubic feet per second, but a flood flow of from 300,000 to 500,000 cubic feet, the problem is simply one of making up the deficiency in constant flow by storing a surplus in flood season. The brief description of the Assuan Dam shows the method by which storage is accomplished. When needed for irrigation purposes, the water is carried to the fields through 8,500 miles of large canals, and some 45,000 miles of smaller canals and ditches. The Assuan Dam proved its worth in 1913, when Egypt experienced the lowest flood in a century. That part of Upper Egypt not under perennial irrigation suffered because of insufficient water to flood the basins. But the Assuan Dam provided enough irrigation to mature the cotton crop, from which by far the greatest part of the national income is derived.

IRRIGATION PLANS FOR THE FUTURE

Some attention may now be given to a comprehensive plan for further development of Nile irrigation, which is expected to virtually double the area that can be cultivated profitably. The project, devised by English engineers, is to be carried out in three stages. The first is the construction of two great dams, one across the White Nile at Gebel Aulia, about fifty miles south of Khartum; the other at Sennar on the Blue Nile, 240 miles south of Khartum. The second stage is the storage of water on the Upper Blue Nile, at Lake Tana in Ethiopia. The third consists of the utilization of over-year storage at Lakes Albert and Victoria, and drainage of the Sudd region, south of Gebel Aulia, where great waste now occurs. The water obtained through these vast developments is to be divided between Egypt Proper and the Sudan on the basis of irrigable area not yet reclaimed; and the cost is to be distributed in proportion to the benefits enjoyed.

The Sennar Dam, an important part of the first stage outlined above, is already a reality. Originally suggested in 1904, its construction was delayed by questions of finance and the Great War, and it was not completed until July, 1925. It has the distinction of being the longest dam in the world, and it will provide water for 300,000 acres of land suitable for cotton production. Capital is now available for the construction of the Gebel Aulia Reservoir, and work on it will soon be well under way. The remaining provisions of the threefold project belong to the future.

FIGURE 10.—Only in the Fayum can you see so much hill and valley. The Fayum and part of Zagazig have the best of it where scenery is concerned. Note how the banks are terraced to provide farming space. (Courtesy of Board of Foreign Missions, United Presbyterian Church.)

EXTENSION OF AGRICULTURE

It would be difficult to exaggerate the benefits that Egypt has reaped

FIGURE 11.—Women gleaning in the fields after the reapers, like Ruth and Orpah, and Naomi. (Courtesy of Board of Foreign Missions, United Presbyterian Church.)

through the introduction of its elaborate system of irrigation. In the first place, more than 2,000,000 acres have been added to the cultivated area by the dams at Assuan, Assiut, Zifta, Esneh, and Sennar. The extensive improvements yet to be made will, when completed, bring into the productive area an additional 5,000,000 acres—2,000,000 in Egypt Proper and 3,000,000 in the Sudan. But far more important is the extension of perennial irrigation to territory that has heretofore depended upon basin irrigation, and the consequent production of several yearly crops on land formerly yielding but a single crop. Finally, these irrigation projects have greatly increased the area available for cotton, a crop which cannot be grown under the old basin irrigation. The results of these improvements are reflected in increased land values: Land in Upper Egypt (the Nile Valley) which sold in 1900 for $25 an acre, now brings $150, $200, $250, and more, per acre. The average value of good land in the Delta is $700 to $800.

By means of irrigation, about 6,000,000 acres of land in Egypt are made available for agriculture. Two-thirds of this area is in the Delta, and is under perennial irrigation. Four hundred thousand acres are comprised in the Fayum, a province sixty miles southwest of Cairo. Here, too, is perennial irrigation, provided by the Bahr Yusuf Canal, which passes through a break in the desert hills west of the Nile. But of the remaining cultivated area (that is, the Nile Valley proper) a large portion is still dependent upon basin irrigation. Though particular emphasis has been placed upon the use of the dams in supplying water for irrigation, it should not be forgotten that they also act as regulators in time of high flood, so that the peasants now enjoy a sense of security which was altogether unknown under the old system.

EGYPTIAN AGRICULTURAL METHODS

The Egyptian agricultural year is divided into three seasons: Summer, from April 1 to August 1; the Flood Season, August 1 to December 1; and

FIGURE 12.—A market scene in a small village. By donkey and camel and on the heads of the carriers, everything the soil can produce is brought here for sale. (Courtesy of Board of Foreign Missions, United Presbyterian Church.)

Winter, from December 1 to April 1. The chief crops of the summer are corn, cotton, sugar-cane, and rice. Corn and rice are cultivated in flood season. Wheat, barley, beans, and clover are the most important winter crops. Winter was formerly the principal agricultural season, following as it does the rise of the Nile. But under perennial irrigation, crops can be grown all the year round, as has been indicated above. It must be remembered that the seasons sometimes overlap; crops are frequently sown before those of the previous season are harvested. In this way, about one-half of the Delta is made to produce two crops a year. In the case of cotton, for example, planting begins in February and lasts until early April. The land is watered once before planting, and again after the seed is sown. Thereafter it is watered at intervals of from fifteen to forty days. Between late August and early November the fields are picked over two or three times; and when the cotton has been removed, clover is usually sown as a winter crop, also under irrigation. Two crops require about seventy inches of water. Some soil is made to yield three crops annually, if carefully selected crops are planted; this is made possible because of irrigation and the absence of killing frost.

COTTON—THE LEADING CROP

We have noted that perennial irrigation in Egypt resulted from the desire to grow cotton. A century has passed since its introduction, and during that period cotton has made rapid headway, until now the prosperity of the country depends upon the cotton crop. This development is due to the fact that Egypt can produce cotton of high quality and of exceptional yield per acre. The warm climate, the continuous sunshine, and the natural fertility of the soil (supplemented, when necessary, by commercial fertilizer), combine to produce a long, strong, lustrous fibre, second only to American Sea Isle cotton. Egyptian cotton, indeed, is believed to be a derivative of the

Sea Isle, modified somewhat by its changed environment. Because of its excellence, it is used extensively in the manufacture of mercerized goods and high-grade cotton hosiery. For such purposes, the United States, itself the world's greatest cotton producer, imports about thirty million dollars' worth of Egyptian cotton annually. In point of yield per acre, Egypt has no competitors. An acre of average land in Egypt will produce 500 pounds, or one bale, of cotton; and a yield of 800 pounds is not unknown. The cotton fields of the United States yield little better than one-third of a bale per acre, whilst those of British India produce but one-seventh of a bale.

The Egyptian farmers are keenly alive to the situation, as is evidenced by their interest in cotton production. The following table tells the story:

COTTON PRODUCTION IN EGYPT PROPER

Year	*Acres*	*Bales Produced*
1892	864,000	1,000,000
1900	906,000	1,124,632
1905	1,500,000	1,230,641
1910	1,540,000	1,548,713
1913	1,788,571	1,510,800
1920	1,516,000	1,114,400
1921	1,760,500	1,207,200
1922	1,244,700	870,600
1923	1,734,000	1,142,600
1924	1,654,200	1,306,251
1925	1,722,000	1,454,790

Here is seen a steady growth in both area and production up to 1913, the acreage allotted to cotton having doubled in twenty years. The poor yield of 1913, despite the large acreage, must be attributed to the abnormally low flood of that year, with a consequent scarcity of water for irrigation. Data from 1913 to 1919 are omitted; since the government restricted the planting of cotton during the Great War, and at times required the growing of cereal crops, these figures do not represent normal cotton production and may be disregarded for purposes of this study. The startling decline in 1922 may be explained briefly. Cotton prices in 1920 were fabulously high. Good Egyptian cotton brought in Liverpool as much as $1.08 per pound. The price fell in 1921 to twenty cents, and this slump is reflected in the decreased area devoted to cotton in the year 1921–1922, when the acreage in Egypt Proper dropped off one-third and the total crop to an almost equal degree. Since that time there has been a steady increase in the total yearly yield, despite slight fluctuations in acreage. Both acreage and yield are now approximately as great as in 1913. It is not surprising that there has been no great increase since 1913, for cotton production in Egypt goes hand in hand with extension of irrigation, and reclamation projects were virtually at a standstill in the twelve-year period from 1913 to 1925. The one important exception was the construction of the Sennar Dam, which will add appreciably to both acreage and yield. This dam

FIGURE 13.—Coming to market. In her load she probably has pigeons, rabbits, chickens, and turkeys. These Egyptian turkeys are queer birds. They stay where they are put, whereas an American turkey would be on top of the nearest house at the first opportunity. (Courtesy of Foreign Missions, United Presbyterian Church.)

FIGURE 14.—This fleet of dhows is one filling of the lock in the irrigation dam at Assiut. The dam raises water to fill the great canal that waters all central Egypt and the Fayum. The Ibrahimia Canal is the longest irrigation canal in the world. (Courtesy of Board of Foreign Missions, United Presbyterian Church.)

is situated, of course, in the Sudan, where cotton-growing is in its infancy. Only a small part of this region has been able to provide perennial irrigation, the only type of irrigation suitable for cotton production. Since 1919, there has been a slow but steady upward trend, as is shown by the following figures:

COTTON PRODUCTION IN EGYPTIAN-SUDAN

Year	*Bales Produced*
1919	10,469
1920	18,525
1921	23,506
1922	19,707
1923	23,452
1924	40,607
1925	45,307

Egypt Proper produces one-tenth of the world's supply of cotton. Practically all of this is exported in the raw state for manufacture elsewhere. In 1923, 52 per cent of her output went to the United Kingdom, 20 per cent to the United States, and the remaining 28 per cent to other countries. The income from this crop was something more than $250,000,000. The unfailing demand for Egyptian cotton has resulted in the subordination of other agricultural products to this great money-making crop. Almost a third of the land now under cultivation is given over to the growing of cotton. The greater part of this area is in the Delta, since cotton demands perennial irrigation; but portions of the Nile Valley which are able to meet this demand also contribute to the cotton output.

The government is manifesting a lively interest in the methods of cotton growing. Measures have been taken to prevent over-irrigation. War has been declared upon the pink boll weevil, the Egyptian counterpart of the Mexican boll weevil, with whom the cotton growers of the United States have had dealings. Government regulations require the removal and destruction, by January first, of all cotton plants, in order to prevent the hibernation of the cotton boll worm. The problem of soil exhaustion, which often accompanies a one-crop system, is not so serious a matter in Egypt as in America. The fertilizing waters of the Nile aid in combating the evils of the single crop; and, moreover, the summer crop of

cotton is usually followed by a leguminous crop, such as clover, which returns nitrogen to the soil. However, the use of commercial fertilizer is becoming more common, since the additional yield that may be secured in this way more than pays the cost of the fertilizer.

FIGURE 15.—Not beautiful Jersey or Holstein cows, but goats, and these unsightly water buffaloes are Egypt's principal source of milk. They are really more useful than ornamental, however, for their milk is rich. The farmers also use them in the plow and to turn the large water wheels, by which the land is irrigated in low Nile. A good water buffalo, or "gamoosa," is worth about $600. Many a farmer who dresses like a beggar and lives in a mud house owns several of them. (Courtesy of Board of Foreign Missions, United Presbyterian Church.)

OTHER AGRICULTURAL PRODUCTS

Though cotton is far and away the the most valuable single crop, we must not overlook other important phases of agriculture. The growing of early vegetables—potatoes, onions, tomatoes—is increasing in importance. At the present time it means an income of several million dollars. Beans and lentils are grown for home use and export, 500,000 acres being utilized for these crops. Progress may also be noted in the production of sugar-cane. Egypt's output of refined sugar increased fivefold in the three years following 1913; yet by 1924 it amounted to only 125,000 tons. Aside from cotton, then, Egypt makes little pretense of growing crops for export. The value of her cotton exports, in 1924, was ten times as great as that of all cereals and vegetables that left the country. She does, however, produce large quantities of foodstuff for her population and domestic animals. Next to cotton, corn commands the largest attention, since it ranks first as food for the peasantry. The 1,865,000 acres planted to corn in 1923 produced 65,449,000 bushels, or 35 bushels to the acre, a very fair yield. Corn under irrigation requires about thirty inches of water, so that three-fourths of the corn is

grown in the Delta, where it has the benefit of perennial irrigation.

Wheat and barley are also of importance, these crops occupying together about the same acreage as is granted to corn alone, and producing about 36,000,000 bushels of grain. Though grown in Egypt from the earliest times, wheat and barley are of poor quality and possess little market value.

The quantity of rice planted depends upon the apparent abundance of water as estimated by the authorities. In certain years (as, for instance, in 1914) it is forbidden to grow rice, since this is a crop demanding a large quantity of water. The area given over to rice in 1924 was 250,000 acres. The whole of the rice crop is for home consumption. Rice is likely to increase in importance as the salt lands of the Delta along the Mediterranean are reclaimed.

Egypt is just able to meet the demand for foodstuff on the part of her people. Most of the cereals produced at home are consumed by her population, and her exports of grains and vegetables are fairly evenly balanced by imports of foodstuff. Part of the land is used for a winter crop of clover, for hay is necessary for the livestock in the absence of pasturage. Egypt produces a variety of fruits, notably dates, but her imports of fruits, fresh and dried, are twenty times as great as her exports in this line.

LOW STATUS OF MANUFACTURING

Sixty-two per cent of the workers of Egypt are engaged in agriculture. Only about six per cent, or one-tenth as many, are to be found in manufacturing. Much of the manufacturing savors of the olden times, and is picturesque rather than important. The time-honored industries of linen-weaving and fez-making are still carried on, though they are now declining. Pottery is made on a small scale, the most important item being water-jars. Goatskin is dressed and dyed in a peculiar manner, and is sold as Morocco leather. Egyptian cigarettes have long been famous. They are Egyptian in name only, however. Tobacco growing is prohibited in Egypt, and Turkish tobacco grown in Greece and shipped into Egypt is there manufactured into cigarettes by Greek workmen, and then exported. With the mention of a few cotton mills, and a number of sugar refineries worked by foreign capital, the tale is complete.

Thus we see the low status of manufacturing in Egypt. What are the probabilities of future development? They seem to be very slight, indeed. Egypt has never had a chance to become a manufacturing nation, and her future in this respect is not bright. The absence of raw materials, with the single exception of cotton, has already been mentioned. Power is also lacking. Whatever coal is used must be imported. However, this objection may eventually be overcome through the development of electric power from the Nile. The river cuts through rock formations, and the resultant cataracts aggregate a fall of some 900 feet. The possibilities of development along this line are, therefore, very considerable. A more serious obstacle to manufacturing is the labor supply. The Egyptian peasant is wholly unskilled, except in the tilling of the soil. To overcome the environmental influences of seven thousand years, and convert him into a factory operative, is a formidable undertaking. It would be a

difficult task to coax him from the soil. His wants are few and simple. He lives in a mud hut, wears but little clothing, and requires only the simplest of food. Of the 2,000,000 peasant families, more than one-half are landowners. The holdings are small, often only an acre or two, but even this bit of land is sufficient to enable the native to earn a living, and the independent, open-air life is much to his liking. Irrigation has brought certainty of crops; and the fortunes made by small producers of cotton during the Great War seemed only to increase the tendency to stick to the soil. Finally, the climate is not productive of a grade of energy necessary for successful factory operation. In Professor Huntington's study of climatic effect upon energy, the great industrial centers of the eastern United States and the British Isles were given a rating of "100" for energy-producing climate (indicating ideal conditions), whilst Egypt was listed at "57." Perhaps the climate is responsible for the saying common among the Egyptians: "Allah is great, and there is no hurry." At any rate, the influence of climate upon energy is a factor to be reckoned with.

ECONOMIC FUTURE OF EGYPT

Along what line, then, may we look for economic expansion in Egypt? The answer should be fairly apparent. Egypt is the Nile, and the Nile is Egypt, just as truly today as two thousand years ago. The passing centuries have not changed the problem. They have served rather to emphasize Egypt's dependence upon the Nile. The future of Egypt lies in the productivity of her soil, in the extension of agriculture through the extension of Nile irrigation. Land there is in abundance, and land that requires only the application of water to convert it from desert to garden. For the elements essential to successful tillage have been accumulating for ages, and when released through irrigation will produce fine crops. It is a well-known fact that an acre of irrigated land in a desert region frequently has productive capacity equal to eight or ten acres in a humid area.

There can be little doubt that the next decade will witness a rapid extension of land reclamation in Egypt. The Assuan Reservoir, with its supplementary dams, has been an unqualified success. The Sennar Dam, just completed, gives promise of great returns on the investment. Whatever form further improvements may take, the rapid extension of irrigation is bound to occur. Much attention is being paid to the Delta, and a considerable portion of that region is being reclaimed annually by drainage, and by the "washing" of alkali and salt lands.

BRITAIN'S INTEREST IN COTTON

We may reasonably predict that cotton will continue to be the money crop of Egypt. Not only is the country admirably adapted to the growing of cotton, but added to this fact is England's desire to promote cotton production among her dependencies. England must have cotton to keep her textile mills running. She has long been dependent upon the United States for the bulk of this raw material. Several times in the past, notably during the Civil War, she has been seriously handicapped by the inability to secure the necessary supply. The abnormal rate of exchange during the Great War and for some months after the Armistice

increased her dissatisfaction, for with the depreciation of British currency England could not afford to purchase American cotton. We may, therefore, expect to witness a stimulation of cotton production in British colonies. Egypt, we may be sure, will not be overlooked; her great possibilities for cotton production, coupled with England's increasing power in Egypt, will prevent such oversight. The measure of independence that Egypt enjoys is apparent rather than real. So it would seem that Britain holds the power to direct the economic life of Egypt, and that the result is likely to be an extension in the production of cotton.

British control is complete, however, only up to a certain point. Unaffected by the political maneuverings of the ages, the Nile has continued supreme in the economic sphere. "The old order changeth," but only in degree, not in kind. British brains and British capital can extend agriculture; they may stimulate the growing of cotton, or even shift the emphasis to another crop, should one more profitable than cotton be discovered. But they cannot make of Egypt anything but an agricultural country—they cannot lessen her dependence upon the Nile. While history endures it will be said "Egypt is the Nile."

BOOK REVIEWS

DEPARTMENT OF COMMERCE

Bureau of Foreign and Domestic Commerce

Foreign Trade of the United States in the Calendar Year 1927. Trade Information Bulletin No. 537.

The export trade of the United States in 1927 reached a value of over $1,000,000,000 greater than in 1922, and the quantitative volume of the trade increased during this five-year period by more than 40 per cent. This bulletin, which is issued annually by the Bureau, is a brief survey of the most important recent developments in our foreign trade. The principal changes in the composition of our export trade were increases over 1926 in shipments of crude foodstuffs and semi-manufactured articles, and decreases in exports of crude materials and manufactured foodstuffs. The falling-off in our exports of crude materials may be entirely ascribed to the cessation of the abnormal demand for coal which resulted from the British coal strike in 1926, while the lower volume of our shipments of manufactured foods was primarily owing to decreases in both the quantity and value of exports of meats and animal oils. Exports of finished manufactures continued to expand both in quantity and value as a result of the substantially increased foreign demand for American automobiles and machinery.

Taxation of Business in Great Britain. Trade Promotion Series No. 60. Price, 60 cents.

Although this book is not directly geographical, nevertheless the facts contained therein are of considerable value in weighing the significance of geographical factors in our foreign trade.

What sum was paid into the British Treasury by Americans as taxes on the net profits realized from the $973,500,000 worth of exports to Great Britain in 1926–1927 is not known, but a fair proportion thereof undoubtedly bore British income tax, inasmuch as liability to that tax arises whenever an American producer sells his goods in Great Britain through an authorized agent, branch, or subsidiary. The present report was prepared from material gathered by Mr. Carroll, the author, while in Great Britain, from authoritative written sources, and through interviews with tax officials, solicitors, and bankers and business men. This work is probably the first comprehensive study of British taxation that has been made from the viewpoint of Americans selling merchandise and investing money in Great Britain.

Irish Free State as a Market for Electrical Machinery and Supplies. Trade Information Bulletin No. 531.

Although electrical development in the Irish Free State is recent, the market for electrical goods is a promising one, and at the present time considerable quantities of equipment are imported.

German Chemical Developments in 1927. Trade Information Bulletin No. 532.

This report does not present in detail the mergers and amalgamations of commercial interests in Germany, but is rather a sketch of the most significant developments which show concrete accomplishments and progress already made by the German chemical industry as well as the trend of events and probable future developments. Although many phases are involved in the present situation, it should be borne in mind that since the preparation of this report, events of considerable consequence have been and still are transpiring.

Motor-Vehicle Distribution in Cuba. Trade Information Bulletin No. 535. Price, 10 cents.

The United States supplies Cuba with 98 per cent of its motor-vehicle imports, which, according to figures of the Cuban Government, amounted to 5,129 units, valued at $3,445,727, during the year ended June 30, 1927. With the advance in construction of good roads there will be an increased demand for motor-cars.

Market for Canned Foods in British Malaya. Trade Information Bulletin No. 534. Price, 10 cents.

This subject contains numerous possibilities for geographic study. American canned foods of the type not otherwise available in these low latitude countries are finding an increasing market. Owing to the growing importance of the Straits Settlements as a distributing point for American goods, this study has both a local and broader interest.

Foreign Aeronautical Intelligence. Mimeographed circular from the Aeronautics and Communications Section, Transportation Division.

With the growing production of American Aircraft, foreign markets are of especial interest, and this circular indicates ways in which the Bureau is serving the Aircraft industry.

Foreign Commerce and Navigation of the United States for the Calendar Year 1926. Vol. II, Price, $1.75.

A detailed statistical statement for the foreign trade of the United States by commodities and countries of origin and destination.

American Lumber in Japan. Trade Promotion Series No. 59. Price, 15 cents.

Japan depends on foreign countries for nearly one-third of its lumber requirements, and 88 per

cent of its imports in 1926 came from the west coast of the United States. Although this bulletin gives much useful information on various phases of Japan's lumber industry and trade, it deals mainly with the uses and opportunities in that country for west coast lumber.

The following Trade Information Bulletins, price, 10 cents each, are of interest:

Short-Subject Film Market in Latin America, Canada, The Far East, Africa, and the Near East. Trade Information Bulletin No. 544.

French Market for Industrial Machinery. Trade Information Bulletin No. 543.

The European Motion-Picture Industry in 1927. Trade Information Bulletin No. 542.

Iceland. A Brief Economic Survey. Trade Information Bulletin No. 541.

Electrical Equipment Market in Argentina. Trade Information Bulletin No. 536.

Markets for Hand Tools in Continental Europe. Trade Information Bulletin No. 533.

German Metal-Working Machinery, Industry and Trade. Trade Information Bulletin No. 540.

Peru as a Lumber Market. Trade Information Bulletin No. 539.

The Fish Meal Industry. Trade Information Bulletin No. 538.

China Trade Act, 1922, with Regulations and Forms as of February 26, 1925.

This act has proved of great benefit to American merchants engaged in the development of trade with China, and has made it possible for American business concerns operating in China to be on the same favorable basis as their foreign competitors in respect to the exemption of taxes to their respective governments on net trading profits derived from operation in China. Though recent and continuing political difficulties have retarded business in China, our trade in that country has possibility for substantial development as conditions improve, and the corporations now registered under this act form a strong nucleus for an expansion.

U. S. Coast and Geodetic Survey

The Coast Survey has recently issued three supplements to the United States Coast Pilot which are of value to Geographers in that they make available information not elsewhere accessible: Cape Cod to Sandy Hook; in the Philippine Islands,—Palawan, Mindanao, and Sulu Archipelago; and also in the Philippine Islands, Luzon, Mindoro, and Visayas.

Survey of Current Business. Published monthly. Subscription price, $1.50.

This presents each month a picture of the business situation by setting forth the principal facts regarding the various lines of trade and industry. Supplemental to the *Survey of Current Business* is a *Record Book of Business Statistics*, Part II, Metals and Machinery, a text and statistical description of the industry.

U. S. Bureau of Mines

Analyses of Oklahoma Coals. Technical paper No. 411. Price, 10 cents.

Electric-Furnace Cast Iron. Technical paper No. 418. Price, 10 cents.

Mining of Thin Coal Beds in the Anthracite Region of Pennsylvania. Bulletin No. 245. Price, 30 cents.

Bureau of Fisheries

Annotated List of Fishes Collected in the Vicinity of Greenwood, Miss., with descriptions of Three New Species. Bureau of Fisheries Document No. 1027. Price, 15 cents.

Production and Distribution of Cod Eggs in Massachusetts Bay in 1924 and 1925. Document No. 1032. Price, 15 cents.

Quantitative Study of the Changes Produced by Acclimatization in the Tolerance of High Temperatures by Fishes and Amphibians. Document No. 1030. Price, 10 cents.

Fishery Industries of the United States, 1926. Document No. 1025. Price, 25 cents.

Fishes of Chesapeake Bay. Bulletin of the U. S. Bureau of Fisheries. Volume 43, 1927. Part I: price, $1.50.

Trade in Fresh and Frozen Fishery Products and Related Marketing Considerations in Greater St. Louis, Mo. Document No. 1026. Price, 10 cents.

NAVY DEPARTMENT

The Hydrographic Office

American Practical Navigation. Originally by Bowditch, publication No. 9, edition of 1926. Price, $2.25.

Contains much information of interest to geographers.

Panama Canal

The Panama Canal Record. Published weekly. Subscription, 50 cents a year. Published by the Panama Canal, Washington, D. C.

HELEN M. STRONG.

HUNTINGTON, ELLSWORTH. *The Human Habitat.* viii and 293 pp., illustrated with 26 photographs and 8 maps. D. Van Nostrand and Co., Inc., New York, 1927. $3.00.

Another book from the pen of Ellsworth Huntington does not startle geographers, for we are coming to expect a new one every few months. But where is there a geographer, or any other student of human affairs, who would dare to regard *The Human Habitat* as "just another book." The author with his astounding knowledge of the several fields of geology, anthropology, history, climate, and geography has collected, as it were, specimens or samples of human habitats, and in the descriptions of the geographical relationships propounded for the layman the philosophy of geography. He applies the microscope and examines in detail the activities of man in selected regions with a view of explaining, as far as possible, how the inhabitants are related to their habitat. In Chapter IV, "The Desert Borderlands," the author chooses as a specimen habitat the fringe of the Kalahari Desert, and with characteristic clearness, he compares the

Bushmen within the drier portions with the Ba-Kalahari, and, these in turn, with the Hottentots in the more hospitable sections. From this particular region the principles are evolved, leading to the usual generalizations concerning the characteristics of people who dwell along the margins of deserts. Similarly, Chapter XVI, entitled "The Relationship of the Soil to Aristocracy and Democracy," is a rather detailed description of the influence of the soil upon human affairs in Alabama, with particular reference to the Black Belt, where there arose from the soil a white, educated, landed aristocracy, and a black illiterate peasantry.

There are chapters which were designed to give the reader the picture as a whole as well as its parts. Chapter I, "The Terrestrial Canvas," is an admirable evaluation of the elements of man's habitat. In turn, he considers the distribution of continents and oceans, climate, relief, soil and natural vegetation, with a view to measuring their importance as conditions of the physical environment.

Because this book is one of the series of the Library of Modern Sciences, the author had his original plan so altered that he had to omit chapters on cities, commerce, and minerals. Certainly the geographical picture is not complete without a treatment of a habitat where a mineral resource is the dominant element of the environment.

The Human Habitat is an interesting book, and convincing. The reader will find himself persuaded to accept the geographical philosophy, which is common knowledge to the geographers, but all too foreign to the layman. This book has as its aim the dissemination of principles of geography to a wider public than receives them by the usual method of collegiate instruction.

GUY-HAROLD SMITH.

N. I. VASILOV. *The Agricultural Map of U. S. S. R.* 28th supplement to the "Bulletin of Applied Botany and Plant Breeding." 90 pages and 1 map. Leningrad, 1926.

In many fields of scientific research the Union of Soviet Socialist Republics seems to be working energetically and productively. Its alphabet and language impose such great difficulties upon us West Europeans, however, that we can follow their results only with effort into the valuable fields and opportunities which they are developing, particularly because the Russians almost always publish in their own language and rarely deign to give a summary in any European language.

Since the language of maps is international Russian maps can be understood by everybody, and it is for this reason that the map under review has attracted my attention. The map is, so far as I know, the first rather complete compilation and presentation of agricultural statistics in the Soviet Union. It is a dot map in which every dot represents 1,000 hectares cultivated land. It is true that the size of the dots seems exaggerated even if they do not crowd the map. The more generalized American method of dot map has been followed rather than the more exact Swedish system with its controlled distribution and proportionate size of dots.

The map shows nothing particularly noteworthy beyond what has been known or conjectured before, but it does indicate clearly the relative location and distribution of the cultivated land over the wide extent of the gigantic Soviet Empire. It reveals among other things that the most of the cultivated land (about 50 per cent) is found in the southern part of European Russia, while the vast Siberian areas are but intermittently cultivated chiefly along the Trans-Siberian Railway and self-evidently in the spots where irrigation is possible in the great territory of Russian Turkistan where desert will always reign. General agriculture in European as well as in Asiatic Russia depends chiefly upon the black earth, or chernosem, soil; and while other soils are utilized in European Russia to a considerable extent, in Siberia agriculture is almost entirely limited to the black earth, or chernosem-zone. It is evident that even with present prices of cereals, considerable stretches of territory in Siberia may be utilized for agriculture even though the cold boundary cuts off about half of Siberia from cereal production, and even if, of the remaining part, particularly Turkistan, with the greatest extension and highest development of irrigation must in the future, as at present, always remain steppe or desert grassland.

Accompanying the map a text of not less than 90 large pages written entirely in Russian explains the map and the several smaller sketches concerning agriculture which deal with certain smaller areas, but its value to the foreigner who cannot understand Russian and who cannot criticize the value of the literature cited is almost negligible. Finally, it is perhaps worth while to compare the area of the several major divisions of the Soviet Republics with the land under cultivation and the population according to the Soviet Union Year-book, 1927.

	1,000 cultivated land in Hectares	*1,000 land area in Hectares*	*Population*
Russian S. F. S. R.	73,908	1,944,263	96,612,319
Ukrainean S. S. R.	22,094	42,970	27,301,852
White Russian S. S. R.	2,537	10,816	4,262,449
Transcaucasian S. F. S. R.	2,118	16,351	5,554,031
Uzbekian S. S. R.	2,101	32,200	4,803,600
Turkomanian S. S. R.	229	47,300	914,558
Total	102,987,000	2,093,900,000	139,448,809

OLOF JONASSON.

MARTIN, C. C. *Can We Compete Abroad?* 155 pages. The National Foreign Trade Council, 1926.

This timely volume, the scope of which is admirably, though somewhat incompletely, in-

dicated in the above title, is a unique contribution to the already extensive post-war literature dealing with our foreign trade. The author's answer to the above question is, emphatically, yes. He concludes that not only can we compete but that the foreign merchant and manufacturer has a not unjustified feeling of apprehension, and considers it necessary to point out that "a monopoly of world trade for us would be an unmixed disaster."

The evidence presented in support of the above conclusion consists of a brief analysis of recent export statistics, a statement of the trend of manufacturing costs, a study of numerous illustrations of success on the firing line of the American trade frontier and of testimony both at home and abroad.

An important part of his argument is that our foreign trade is merely an expansion of domestic trade and that there is no essential difference between selling goods at home and abroad. Hence, when the same intelligent technique and energy is applied to the foreign market as is now applied by successful competitors in the home market, success in foreign selling is assured. Abroad, as at home, such factors as "quality, prestige, friendship, influence, service, style, quick delivery, ability to sell, advertising, novelty, adaptability, habit, accessibility, etc.," as well as price competition, are factors in making a sale.

The purchase of American locomotives by the Argentine Government at 38,000 pesos per machine higher than European quotations, because the Baldwin Locomotive Works could do what Continental manufacturers said "could not be done," viz., deliver them "under steam on the rails at Entre Ríos ninety days after receipt of order," is cited as an illustration of the operation of factors other than price. Our ability to sell manufactured goods as well as copper, cotton, tobacco, etc., which "sell themselves," since the world needs them and we are the cheapest market, is shown by the fact that 60 per cent of the 4.9 billion dollars' worth of goods shipped abroad in 1925 consisted of manufactured or partly manufactured goods "that depended in good part for their movement on competitive selling."

A statement of our enormous productive power and expansion in wealth as related to foreign commerce also is presented as convincing argument. "Our national income in 1920 was $74,158,000,000—some ten times that of Great Britain and Germany. Our national wealth in 1922 was $320,000,000,000 as compared with $88,000,000,000 in 1900 and $30,000,000,000 in 1870 . . . we have 6 per cent of the population of the world, but we use one half of the basic materials of commerce. . . ."

"This colossal accumulation of power in the hands of a homogeneous, united people practically protected against foreign aggression is bound to lead." Our competitors abroad see massed, in the United States, wealth and productive power greater than the world has ever known, greater than could be assembled by our united trade rivals. They see this wealth and the product of this industrial power sweeping along trade channels of large and small countries, and the banners of our commerce carried forward by skilful men who will not be stopped. They see our government officials and representatives of business organizations examining minutely the commercial fields of the world, and they note an avalanche of printed material in all languages, seeking the buyer in the remotest hamlet, telling him the story of American goods. They find a condition of high wages and immense domestic purchasing power in the United States, leading to manufacturing methods and inventive initiative not approached in any other country, nor to be approached in a definite future, and they see billions of American money going abroad to provide insurance for raw materials, save governments and obtain seats of influence in innumerable activities.

Our industrial and commercial progress has been so great that something approaching a new type of culture has evolved. "In form, in effort, in initiative, in method we are different in many ways from the rest of the world. We are contributing a new leaven to thought and trade." Mr. Martin agrees with Dr. Hursch (Das Amerikanische Wirtschaftswunder) that "European industry and commerce cannot help being Americanized," though holds with Herr Arthur Feiler (Amerika-Europa) that Europe cannot obtain the same results. "Europe can expect half the reward at most."

Moreover, "the period of the world's history known as the colonial, where vast sections of the earth were ruled by some relatively small European unit, has passed, never to return. In the future there will emerge great states, comprising large areas to an extent self-contained." The United States is the typical example today of this new type of world power, just as the maritime colonial state, with a European base and widely scattered colonies, was the type from the sixteenth to the nineteenth century.

There is encouragement for all, however, since as "higher wages and better standards of living become typical for many backward countries, increased demand will emerge in these places while many new markets will arise in China, South America, Africa and other parts of the world based on a variety of circumstances." And as a result Mr. Martin believes there will be plenty of trade for all.

C. J. BOLLINGER.

JONES, CLARENCE F. *Commerce of South America.* xvi and 584 pp.; maps, diagrs., ills.; preface, table of contents, bibliography, index. Ginn and Company, Boston, 1928.

A notable treatment of South American commerce. In 553 pages is given one of the most scholarly and most interesting accounts of South American commerce and geography extant. In these days when the business man and the eco-

nomic geographer face an avalanche of literature on Latin America, a large portion of which is poorly or at least only fairly well done, and most of which smacks of propaganda, and is therefore unreliable, they naturally will welcome such a book as *Commerce of South America*, which is based on government statistics, reliable literature, and field investigations.

It consists of thirteen chapters: the first and last are "The Character and Distribution of South American Trade" and "The United States and Its Chief Competitors in South American Trade," while the eleven intermediate ones deal with the trade of the various countries.

The treatment of each chapter revolves about the growth of trade, but always in the light of *geographic environment*. While the trade is discussed from the standpoint of the country in each case, constant reference is made to that within the geographic regions constituting each political division. This arrangement will suit those who want to teach trade by countries as well as those who prefer to do it by regions.

In each chapter the material is divided roughly into the following main topics: (1) the growth of trade—export and import; (2) the trade by countries; and (3) the future possibilities. Under the import and export trade a detailed and well analyzed treatment of each commodity is presented. Under the topic "trade by countries" attention is focused upon the trade between each South American country on the one hand and the United Kingdom, the United States, Germany, France, and neighboring republics on the other. Here America's preëminent position is lucidly portrayed; as Doctor Jones puts it, "Now that the United States has become an industrial nation, an importer of raw materials and tropical foodstuffs, and an exporter of manufactured or semimanufactured wares and prepared foodstuffs, it stands head and shoulders above European countries in competitive ability in the commerce of this southern continent."

It is enlightening to learn that from the three-fourths of South America, which is tropical, goes only one-fourth of the exports and that to it comes an even smaller part of the imports; and that from the temperate one-fourth goes three-fourths of the exports and to it come practically all the imports. This is attributable to the fact that the denizens of the tropical portion produce little more than they actually need. Where few clothes are required, where a rude hut affords ample shelter, and where a few banana trees and a patch of corn, beans, and manioc supply food, there is no incentive to work. *More* work cannot be gotten from the natives by paying them larger wages, for they then work fewer days per week. To them the most covetous luxury is *ease*, and they are loath to sacrifice it for something less desirable.

One of the most significant facts about the distribution of South American trade is that about 90 per cent of the foreign commerce of the ten republics is with countries outside the continent. There is little intra-continental trade.

Several key statements regarding the future possibilities of each state snatched from their proper settings follow:

1. "Argentina stands upon the threshold of a period of power and position in the family of nations. Its growth in influence and wealth as the years pass may startle the world."
2. With the fulfillment of these needs—a virile population, transportation facilities, and a stable government with economically sound trade policies—Brazil can become the industrial and commercial master of the southern hemisphere.
3. "It is only a matter of time until the sunny lands of Mediterranean Chile, the coal and mineral resources, the potential power . . . , the tranquil forests, and the oppressed Chilean *roto* combine to expand agricultural, industrial, and commercial activity beyond the dreams of the present government, and to enrich the financial, political, and social life of the republic."
4. " . . . the Peruvians . . . are suave, courteous, emotional, and hospitable almost to a fault, and they never let questions of business cramp their social obligations. It is upon this class of people that the commercial progress of the country largely rests. The republic lacks a middle class. . . ."
5. Uruguay's future looks bright. Ere long crop production will sweep like a great wave across the pastoral domain of former years and will multiply the trade of the country in both value and volume.
6. Colombia's biggest obstacle to progress is the lack of transportation, the key to modern progress. The heart of the country is largely dependent upon the Magdalena River for transportation.
7. "As a tropical country, rich in natural resources, Venezuela may look forward to continued development, even though the immediate future seems dim, the result of conditions in the petroleum industry and the distinctly unfavorable weather in the last two years."
8. The commercial importance of Bolivia must for a long time depend essentially upon her production of minerals, despite her fertile potential agricultural lands in the Yungas.
9. Because of Ecuador's small and diverse population, its political disquietude, and its unstable finances, it will be handicapped relative to commercial expansion, since it will encounter great difficulty in attracting foreign men and money.
10. Contrary to what the average person might surmise, Paraguay has a future, for it is thrice the size of New England, has rich forests, fertile agricultural land, and nutritious grassy plains.
11. While each of the Guianas has rich natural resources of fertile alluvial soils, magnificent forests, fine grazing lands, and extensive mineral deposits, each also is handicapped by transportation, labor, capital, and to some extent by climate.

After a perusal of this volume, there can be little doubt in any reader's mind regarding the value and effectiveness of a geographic background for a study of commerce. The late Professor Charles R. Dryer expressed this most effectively when he said, "Nothing serves like physiographic explanation to make economic statistics palatable, and geography proves more interesting and satisfactory than physiography or economics."

The book contains 204 photographs, maps, and diagrams. The majority of the photos were taken by the author and illustrate geographic principles very well indeed. The maps and graphs are excellent; they are pleasing to the eye, neat, accurate, and effective, and supplement the textual material in no small degree.

The references at the end of the book will be found helpful to advanced students who wish to

secure additional information; they are carefully selected, interesting, and varied.

An innovation worthy of note is the pronunciation of many Portuguese and Spanish names in the index. This will save the busy teacher, initiated into the mysteries of these two languages, much time and perchance some embarrassment.

Finally, *Commerce of South America* is a real contribution to the literature of that continent and in many respects stands without a rival. It is presented in a style that is pleasing and entertaining, despite the fact that it is packed with statistical material, and it has been most carefully edited.

LANGDON WHITE.

WILKINS, V. E. *Research and the Land.* Ministry of Agriculture and Fisheries, xiv and 324 pp.; prefatory note, introduction, table of contents, list of illustrations, appendix, index, illustrations. London, 1926, 65 cents.

Research and the Land is a popular but scientific survey of British research in agriculture and horticulture from 1921 to 1926. Its purpose is excellently given by the Minister of Agriculture and Fisheries, Walter Guinness, in his prefatory note: "I trust that this book will do something to that end by assisting farmers to understand how the man of science works, what he is 'getting at' (if I may be allowed to phrase) and what still requires to be done before the results which he obtains can be absorbed into the ordinary practice of agriculture."

In a total of thirty chapters the author discusses in an able manner the salient problems being attacked in every phase of the country's agriculture. While the book consists for the most part of material too technical for practical use by the geographer, it nevertheless makes worth-while reading and contains much of real value.

Points of geographic interest follow: Lucerne (alfalfa) was introduced into England from France long ago, but its production has been confined almost exclusively to the southeastern part and to East Anglia. One limiting factor until recently was the fact that the easily obtainable *Provence* variety could not withstand cold weather. This difficulty, however, no longer exists, as a number of hardier strains have been developed. The chief retarding factor now is that the type of bacteria in the soils will have nothing to do with lucerne. It is suggested that in time, perhaps, the bacillus might become distributed throughout the whole country as it now is in the southeast, but English farmers cannot go through the pioneering stage. They are accordingly looking to the bacteriologist to solve their problem, and, judging from present indications, they will not be disappointed.

While wheat growing is at a low ebb in Britain, it is not because the plant breeders are not on the job, for no better yielding varieties are extant than the English. The tendency to lodge—long a limiting factor to yield—has been largely overcome in two of the latest wheats, *Yeoman* and *Swedish Iron*. One of these varieties has yielded as many as 96 bushels per acre.

England supplies about one-sixth of her total wheat requirements, but "if the suitability of our wheats for the various purposes of the market were known, and if farmers would take more interest in the marketing question and grow varieties with that definite end in view, a good deal could be done—even without a subsidy—to restore the fortunes of English wheat growing."

The reader may be surprised to learn that "although grassland farming is the predominant feature of British agriculture, and our flocks and herds occupy a leading position in the world's markets, the bulk of our scientific breeding work has in the past been done on cereals, and little attention has been paid to grasses. The balance has lately been redressed, and we are fortunate today in the possession of two Research Institutes investigating herbage questions. . . ."

About one-sixth of the flax requirements of the isles is produced at home—particularly in Ireland, whose climate is excellent for fiber flax. Since fiber flax seed does not do well in Ireland, its farmers import their supply either from England or from countries abroad.

Flax makes a splendid crop for the British Isles to produce, for it is sown late and matures quickly. Moreover, it has heavy labor requirements. Such technical operations as retting and scutching are now done by machinery.

The disposal of whey presents a real problem in England now that the cheese depot has supplanted the farm dairy. If whey is turned into sewers, it affects the sewer *en route* to the sewage works, and there disorganizes the work by fouling the filter beds and putting them out of action; if turned onto the land, it creates an objectional odor and is likely to destroy vegetation; and if run into streams, it pollutes them. The government is trying to find industrial uses for it, and probably will make refined lactose. It is said that approximately 400 tons of lactose are used annually in Britain at a cost of from 60 to 90 pounds per ton.

Attention is called to an agricultural atlas of England and Wales, which should be of inestimable value to geographers the world over. Its dot maps of production are made on transparent paper and are accompanied by maps, on the same scale, of climate, geology, and relief. This arrangement offers an ideal opportunity for a study of the interrelation of the cultural and natural landscapes.

Appendix II is a bibliography of all the agricultural and horticultural research work published in the British Isles from 1922 to 1925.

Mr. Wilkins is to be congratulated upon this work—an excellent attempt to develop a better understanding between the farmer and the scientist. When these two groups get together and

really work coöperatively, man will have gone far in his conquest over nature.

Copies of *Research and the Land* may be secured from the British Library of Information, 44 Whitehall Street, New York City.

LANGDON WHITE.

DENIS, PIERRE. *Amérique du Sud.* (Geographie Universelle, Volume 15, 1927.) 2 Parts. Published under the direction of P. Vidal de la Blache et L. Gallois. 479 pp.; 82 plates, 29 figures, 2 colored maps. Librarie Armand Colin, Paris.

These two volumes, containing a comprehensive geography of South America, form part of a great work on the geography of the whole earth, projected before the war by P. Vidal de la Blache, to succeed Elisée Reclus's classic and standard work.

A number of circumstances, primarily the war and the great economic changes subsequent to it, delayed the plans for carrying it into effect, while their author was still living. The name of this much lamented geographer, who did most of the preparatory work, however, remains intimately bound up with this series of publications, a fitting memorial to V. de la Blache, the great master of geography. Two volumes of this series have heretofore been reviewed in ECONOMIC GEOGRAPHY: *Les Isles Brittaniques* and *Belgique—Pays Bas*, written by a man who is well acquainted with these countries, the distinguished geographer, A. Demangeon. Both volumes are examples of the modern methodic treatment of regional geography.

The present volumes bear the name of an equally well-known author, Pierre Denis. Most students of geography and especially those who have focused their attention on the southern half of the New World have valued highly his work on Brazil, which was published in English in 1911, 1919, and 1921, and also his work on Argentine, a translation of which appeared in 1922 under the title "*The Argentine Republic, Its Development and Progress.*"

Those who are familiar with the bibliographies of the *Annals de Géographie*, devoted to South America, can appreciate the extent of the author's knowledge of the literature, which, with his visual acquaintance with the countries concerned, forms the solid foundation for his present work. In every respect it comes up to the high standard set by Demangeon in the afore-mentioned volumes of the series.

The first part of this geography of South America is devoted to the general character of the continent, the physical bases being considered first. Briefly related are the growth of the continent in geological times and the formation of its coastline. A concise description follows of the three major physiographic regions: the massifs of Guiana and Brazil, the great lowlands, and the Andes. A chapter on climate and its influence on the vegetation forms a third section.

The human factor in the occupation of South America occupies an important part in the general introduction. The indigenous populations, their wanderings, vicissitudes, and present status, are all explained. The influence of the whites, the different aspects of their modes of colonization, and their influence upon the composition of the population are admirably treated. The chapter on colonization includes, besides a general exposition of the economic development of the continent, a section devoted to the present place of South America in the world trade.

The major part of the work contains a treatment of the continent from a regional point of view. The main units, formed by the different countries, are distinguished among the three principal regions: tropical South America (Guiana and Brazil), the Andean region (Venezuela, Colombia, Ecuador, Peru, Bolivia, and Chili), and the countries of the Rio de la Plata (Argentina, Paraguay, and Uruguay). Within each main unit, the geographic regions, that are based largely on physiographic characteristics, have been treated according to the plan pursued in the general introduction: an explanatory description of structure, relief, climate, vegetation, population, and economic activities. Numerous maps and many well-chosen photographs aid the reader in obtaining a clear-cut picture of the various landscapes.

This regional treatment of each country is followed by a chapter or section in which population and economic conditions are considered for the country as a whole, by a bibliography in which the most important sources are enumerated, and by statistical material that is restricted to data relating to area, population, and density of population in the chief administrative subdivisions.

An alphabetical index of geographical names, and a very complete table of contents add to the value of the book. It is to be regretted that a double legend has been used for most of the maps, because this decidedly hinders easy reference. The colored map which shows the relief and the political divisions would have been better inserted in the first volume. The economic map of South America is too crowded to give a clear picture of the main economic facts. More maps showing the distribution of crops and livestock would have been desirable, and more facts of economic geography could have been brought in advantageously.

The reviewer was unable to find, for example, information about storage conditions for agricultural products at the railroad stations in Argentine, the spheres of influence of the railroad lines; the effect on land utilization; the future of truck transportation in the Pampa; and the influence of the valorization scheme for coffee in Brazil. The number of references on economic geography questions is too restricted.

This geography of South America, is, without doubt, one of the most important works on that

continent published in recent years. It will remain for many years a standard work with which every student of geography ought to become acquainted.

WILLEM VAN ROYEN.

COLLINGS, GILBEART H. *The Production of Cotton.* vi and 256 pp.; illustrations, appendix, index. John Wiley & Sons, Inc., New York, 1926. 6 x 9 inches. $3.50.

Dr. Collings, an agronomist, simply and clearly presents in a book intended as a text in agricultural colleges a mass of material from many publications and from his own observations. Although the contents are largely non-geographic, the book will help a geographer form a correct picture of life in the Cotton Belt.

The boll weevil has destroyed the sea island cotton industry and caused considerable decrease in the length of fiber of the American crop. The rapid maturing varieties which yield a fair harvest before the weevil becomes numerous in the late summer have rather short fibers. The crop of American-Egyptian cotton, which reached 92,000 bales in 1920, dwindled to 4,000 bales in 1924. American upland varieties are competing with the Egyptian in the fields of the southwest, where cotton is a good crop to rotate with alfalfa because bermuda grass-infested alfalfa fields can be rid of that pest by cotton culture.

It is a valuable book for every one interested in cotton, for every economic geographer, and for the layman as well.

MOINA PRATOR.

BOOK NOTICES

RÜHL, ALFRED. *Vom Wirtschaftsgeist in Spanien.* 90 pp. 8½ x 5¾. Verlag Quelle & Meyer, Leipzig, 1928. 4 M.

Another valuable addition to the series of which the first numbers have previously been reviewed in ECONOMIC GEOGRAPHY. The Orient, America, Russia, and South America have already been treated. The series is of extreme value to the economic geographer.

NUTTEN, G. E. *Peeps at Great Explorers:* Marco Polo, Scott, Sir George Columbus, Captain Cook. The Macmillan Co., New York. $1.00 each.

These excellently prepared and illustrated books constitute a most interesting series, not only for children but for grown-ups, and even blasé geographers as well. They are written in clear readable English and set forth the salient facts in the interesting lives of these adventurous men. The series should be in every school library.

JAMES, E. O. *The Stone Age.* xv and 200 pp.; index and many illustrations. The Macmillan Co., New York, 1927. $1.40.

A concise summary of present knowledge of man's history, chiefly in Europe and in Britain, from the dawn of the Stone Age to the beginning of civilization, in which much prehistoric economic geography is presented. The background of early social and economic development is interestingly described, and upon this background the activities of our barbarous ancestors is boldly sketched. A worth-while book.

CHISHOLM, GEORGE G. *Handbook of Commercial Geography.* 825 pp.; maps, tables, appendix, and index. Longmans, Green & Company, New York, 1928. $7.50. Eleventh edition.

This eleventh edition of the classic textbook in commercial geography is revised throughout as of this year. The distinctive character and unmistakable stamp of the personality of its author have been carefully preserved and only such alterations have been made as time has rendered necessary and the development of industrial progress have demanded additions. As stated in the preface to the first edition, three classes of readers have been held chiefly in view—first, teachers who may wish to impart additional zest to their lessons in geography from the point of view of commerce; secondly, pupils in the higher schools and colleges that are now devoting increased attention to commercial education; and thirdly, those entering on commercial life who take a sufficiently intelligent interest in their business to make their private studies bear on their daily pursuits. The volume fulfills this aim.

In this revised edition the statistical tables have been extended and increased in number. The effect of the World War has been better portrayed. The extensive labor unrest is discussed to better advantage. All the marvelous recent developments in world trade have been evaluated. It is a surpassingly fine book.

WRIGHT, PHILIP G. *The Tariff on Animal and Vegetable Oils.* With the aid of the Council and Staff of the Institute of Economics. 347 pp.; appendixes and index. The Macmillan Company, New York, 1928. $2.50.

Best summarized by the concluding paragraph by the Director, Harold G. Moulton's preface, "The present study of the animal and vegetable oils is one of a series on agricultural products. Studies on sugar, wool, and cattle and beef have already appeared, and a study on wheat is in preparation. Hitherto protection has been applied chiefly for the benefit of manufacturing interests. Recently, however, farmers, feeling that these manufacturing interests were benefiting at their expense, have sought to 'equalize the benefits of protection' by imposing higher duties on agricultural products. The Institute's studies should be of service to farmers by showing them the extent to which they do in fact benefit and can expect to benefit by such duties, and hence aid them in deciding on the wisdom of the policy on which they have embarked," it is only just to state that every student of economic and commercial geography and of agricultural geography and land utilization should have this book.

ALSBERG, C. L., and TAYLOR, A. E. *The Fats and Oils: A General View.* Fats and Oils Studies, No. 1, February, 1928. 103 pp. Food Research Institute, Stanford University, California, 1928.

With the rapidly growing import of vegetable fats and oils into the United States to compete with both the animal and vegetable fats produced within the country the problem of protection of the American farmer by a double tariff must be considered by the economic geographer, and any national policy dealing with agriculture must take into consideration this problem, which this book discusses impartially and factually from an American point of view and taking the whole subject into consideration.

SNODGRASS, KATHARINE. *Copra and Coconut Oil.* Fats and Oils Studies, No. 2, April, 1928. 135 pp.; maps, charts, tables, appendix, bibliography. Food Research Institute, Stanford University, California, 1928.

The general discussion of the oils and fats in the previous volume is continued in the special field of copra and coconut oil in this volume. The significance of these commodities in American trade and upon American agriculture is thoroughly presented after an exhaustive investigation of all the facts bearing upon it. The bibliography at the end of this volume is adequate and satisfactory.

JAMES, HENRY FRANCIS. *The Agricultural Industry of Southeastern Pennsylvania.* A Study in Economic Geography. 168 pp.; tables, illustrations, bibliographies. University of Pennsylvania, 1928.

Another valuable contribution to regional geography in which *The Agricultural Industry of Southeastern Pennsylvania*, one of the most interesting regions in the United States, is exhaustively presented. The value of the region for high-grade general agriculture is set forth, and the historic influence of the physical and economic factors in the development of the region are interestingly presented. It is a most valuable investigation and study.

RUSSELL, ISRAEL C. *North America.* Second edition. 435 pp.; maps, illustrations, appendixes, index. Oxford University Press, New York, 1927. $4.25.

An anachronism.

"A complete review of the geography of North America covering the topography, climate, plant life, geology, aborigines, and political geography of this continent" twenty years ago. Not a single reference later than 1902 is given, and much of the text seems as antiquated. All the excellent researches and publications since that time have been ignored. Certainly the original author would never have countenanced the issuance of such a "revised" edition.

DIETRICH, BRUNO. *Grundzüge der allgemeinen Wirtschaftsgeographie.* 223 pp.; maps, tables, bibliography, index. Verlag von Gebrüder Borntraeger, Berlin, 1927. 8,70 M.

A compact and yet very satisfactory discussion embracing all the fields of the subject outlined in a logical and convincing way with maps and charts remarkably pertinent and illustrative. To one who reads German easily, this book will prove of great value and for every student of geography the carefully selected bibliography, which with the index concludes the volume, will be of tremendous help.

ECKERT, MAX; PHILIPPSON, ALFRED; and THORBECKE, FRANZ. *Düsseldorfer Geographische Vorträge und Erörterungen.* In drei Teilen. 262 pp.; illustrations, charts, bibliographies. Ferdinand Hirt & Sohn, Leipzig, 1927. 29 Reichsmark.

This interesting volume is divided logically into three parts, as follows: Part 1, Kartenwissenschaft und Wirtschaftsleben, edited by Professor Doctor Max Eckert; Part 2, Zur Geographie der Rheinlande, edited by Professor Doctor Alfred Philippson; and Part 3, Morphologie der Klimazonen, edited by Professor Doctor Franz Thorbecke. All three of these parts are excellently organized and excellently presented. While Part 1 is of much general interest to all geographers, it is particularly valuable to the cartographer. Similarly, Part 2, the regional geography, will be peculiarly interesting in the thorough treatment of the Rhineland, and even more emphatically does Part 3 become of particular interest to the climatologist. The volume is exceedingly valuable.

FELS, EDWIN. *Verhandlungen und Wissenschaftliche Abhandlungen des 22. Deutschen Geographentages zu Karlsruhe.* 237 pp.; map, charts, illustrations, bibliography. Ferdinand Hirt, Breslau, 1928. 15 Reichsmark.

As the two previous reviews have already indicated, the German geographers are working as industriously in their field as the German people as a whole are astonishing the rest of the world. This account of the transactions of the Karlsruhe Geographic Conference is convincing evidence of the wide field that German geography is covering, and of the value to German industry and German life of their results.

WISSELINK, J. *De Vestigingsfactoren der Katoenindustrie in de Vereenigde Staten van Noord-Amerika.* 465 pp.; map, tables, bibliography. Nijgh & Van Ditmar's Uitgevers-mij, Rotterdam.

Like their German neighbors the Dutch geographers are exceedingly active, particularly in the field of economic geography, and this comprehensive study of the cotton industry while containing much that is well known and trite also

presents some interesting points of view that make it exceedingly valuable. It is a book that every student of the cotton industry whether in its production, its manufacture, or its distribution, must take into account in his survey of literature. The author has industriously studied his subject in the field as well as in the literature. His bibliography though brief is valuable but not fully comparable to the quality of the work as a whole.

JENNESS, DIAMOND. *The People of the Twilight.* 247 pp.; illustrations, maps. The Macmillan Company, New York, 1928.

A thoroughly fascinating study of the Eskimo about Coronation Gulf and the northern mainland of North America, their activities, and their response to their sub-arctic environment. While this volume is of interest to every geographer, it has particular value in grade school and high school geography, wherever economic or human geography are given due place in the curriculum.

ANTHONY, H. E. *Field Book of North American Mammals.* 625 pp.; maps, illustrations, pen-and-ink sketches, bibliography, index. G. P. Putnam's Sons, New York, 1928.

One of those books so indispensable to the geographer in the field who wishes to be authentically and accurately acquainted with the environment of the region in which he finds himself. This book is one of a series arranged for field use. It can be carried in the pocket without inconvenience, and yet it is so comprehensive and so thoroughly done—by one of the foremost authorities in his field—that practically everything worth knowing is included.

ALEXANDER, W. B. *Birds of the Ocean.* 428 pp.; illustrations, appendix, index. G. P. Putnam's Sons, New York, 1928.

Of the same series and consequently of the same size and much the same character as the preceding volume, *Birds of the Ocean* fills a want that many a traveler has felt. Geographers who must, by the very nature of their profession, travel a great deal and who often spend weeks and months at sea, will find this field book almost without price, if they are at all interested in the bird life of the seas everywhere they voyage.

HILL, R. T. *Southern California Geology and Los Angeles Earthquakes.* 232 pp.; maps and illustrations. The Southern California Academy of Sciences, 1928. For sale by C. C. Parker, 520 W. 6th St., Los Angeles, Calif. $5.00.

Much interesting geology, but chiefly devoted to convincing the people of southern California, Los Angeles particularly, that they are not in such imminent danger of earthquake catastrophes as some of them have thought.

DAKIN, W. S. *Geography of Connecticut.* 162 pp.; map, illustrations, appendix, index. Ginn and Company, Boston, 1926.

A local geography from the regional point of view, yet is rather better than the average. It is well organized and richly illustrated and so clearly written that any child will have no difficulty with it.

HOBBS, WILLIAM HERBERT. *The Glacial Anticyclones.* 198 pp.; illustrations, maps, index. The Macmillan Company, New York, 1926. $2.75.

In this interesting volume well written, well organized, well printed, and well bound, Doctor Hobbs assembles all the significant and pertinent material on this subject and presents it so convincingly and interestingly that every one can readily read and understand his thesis. It is a valuable contribution to geography, particularly, to meteorological literature.

CRESSEY, GEORGE BABCOCK. *The Indiana Sand Dunes and Shore Lines of the Lake Michigan Basin.* 77 pp.; illustrations, bibliography, index. Published for the Geographic Society of Chicago by The University of Chicago Press, Chicago, 1928. $2.00.

A delightfully thorough and interesting treatment of a technical bit of geomorphology, having great value locally to the people of the Chicago conurbation and the student of sand dunes, and general reference value for the student of geomorphology and geologic processes.

WEBER, JOSEPH J. *Comparative Effectiveness of Some Visual Aids in Seventh Grade Instruction.* 131 pp.; tables, appendixes. The Educational Screen, Chicago.

Of value to teachers of geography because it includes considerable discussion of the problems in the field. An educational book rather than a geography reference, however.

MORTON, H. V. *In Search of England.* 317 pp.; illustrations, index. National Travel Club, New York, 1928.

The record of a motorcar journey round England. Best characterized by the author's statement that, "I have gone round England like a magpie picking up any bright thing that pleased me," but containing so much intimate geography that the student of English geography will profit by sitting down before his fire after his day's work is done and browsing through its interesting pages.

GREEVES-CARPENTER, C. F. *The Care of Ornamental Trees.* 65 pp.; illustrations, index. The Macmillan Company, New York, 1928. $1.25.

A delightful little book for any geographer who delights in trees or makes them his hobby.

W. ELMER EKBLAW.

ANNOUNCEMENT

THE series of articles, *Agricultural Regions of the World*, is continued in this issue with the third instalment of *Agricultural Regions of South America*, by Dr. Clarence F. Jones of Clark University, presenting the latest and most authentic data available on South American agriculture and including a large map in colors indispensable to every student of South America. The sixth instalment of *Agricultural Regions of North America* by Dr. O. E. Baker of the United States Bureau of Agricultural Economics will appear in the next issue.

Agricultural Regions of Africa, by Homer L. Shantz of the University of Illinois and president-elect of the University of Arizona; *of Australia*, by Griffith Taylor of the University of Sidney, one of the foremost geographers of the world; and *of Asia*, by Olof Jonasson of the University of Commerce of Stockholm will follow in later issues to complete the finest geographic discussion of the world's agriculture thus far published.

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Only a limited number of the first numbers of ECONOMIC GEOGRAPHY are available.

The January issue of Volume 3, contains the following articles:

Fisheries of the North Atlantic, J. H. Matthews, Atlantic Coast Fisheries Company.
The Commercial Growth of Peru, Clarence F. Jones, Clark University.
Agricultural Regions of North America, Oliver E. Baker, U. S. Dept. of Agriculture.
A Geographic Reconnaissance of Trinidad, Preston E. James, University of Michigan.
Geographic Aspects of the Prince Edward Island Fur Industry, F. A. Stilgenbauer, University of Michigan.

April includes:

Chilean Commerce, Clarence F. Jones, Clark University.
Siberia—The Storehouse of the Future, Boris Baievsky, U. S. Bureau of Foreign and Domestic Commerce.
Utilization of the Rugged San Juans, W. W. Atwood, Clark University.
British Colonial Competition for the American Cotton Belt, Louis Bader, New York University.
Commerce and Trade Routes in Prehistoric Europe, Herdman F. Cleland, Williams College.
Economic Survey of the Cacao Industry of Trinidad, British West Indies, C. Y. Shephard, Imperial College of Tropical Agriculture, Trinidad.
Colombia's Internal Development, G. T. Renner, Jr., Columbia University.

July includes:

Dairying Industry of New Zealand, Horace Belshaw, Auckland University College, New Zealand.
Agricultural Production in China, Albert La Fleur and Edwin J. Foscue, Clark University.
Agricultural Regions of North America, Oliver E. Baker, U. S. Dept. of Agriculture.
Agricultural Conditions in Florida in 1925, Roland M. Harper, Florida Geological Survey.
Bolivia as a Source of Tin, Harley P. Milstead, Montclair State Normal School.
The Trade of Uruguay, Clarence F. Jones, Clark University.
The Philippine Coconut Industry, Luis J. Borja.
Minneapolis, the Mill City, Daniel R. Bergsmark, University of Chicago.

October includes:

The United States and Its Chief Competitors in South American Trade, Clarence F. Jones, Clark University.
A Nation's Water Power, Herman Stabler, U. S. Geological Survey.
Agricultural Regions of North America, Oliver E. Baker, U. S. Dept. of Agriculture.
Relation of Taurine Cattle to Climate, Fred A. Davidson, University of Illinois.
The Michigan Sugar Beet Industry, F. A. Stilgenbauer, College of the City of Detroit.
The Cotton Industry of Peru, Arthur H. Rosenfeld, Tropical Plant Research Foundation, and Clarence F. Jones, Clark University.

The January issue of Volume 4 contains the following articles:

Agricultural Regions of South America, Clarence F. Jones, Clark University.
The Red Land of Gwent in Eastern Monmouthshire, E. Muriel Poggi, University of Illinois.
Agricultural Regions of North America, Oliver E. Baker, U. S. Dept. of Agriculture.
Cotton Manufacturing—North and South, Robert M. Brown, Rhode Island College of Education.
Distribution of Crops in Peru, Harley P. Milstead, Montclair College of Education.

April includes:

Iron and Steel Industry of the Pittsburgh District, Langdon White, Miami University.
European Forests and Their Utilization, Bruno F. A. Dietrich, University of Breslau.
Agricultural Regions of South America, Clarence F. Jones, Clark University.
Localization of the Cotton Industry in Lancashire, England, Rollin S. Atwood, Clark University.
New York Barge Canal—Expectations and Realizations, Florence Whitbeck, University of Rochester.

Single copies of back numbers of Volumes 1 and 2, 1925 and 1926, will be sent to any American address for $1.75 each; to any foreign address for $2.00. Back numbers of Volume 3, 1927, and Volume 4, 1928, will be sent to any American address for $1.50 each; to any foreign address for $1.75. Whole volumes may be obtained at the yearly rate.

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